About This Guide

This section discusses the objectives, audience, organization, and conventions of this hardware installation and configuration guide.

Objectives

This publication will step you through the initial site preparation, installation, and configuration of the router. Troubleshooting and maintenance procedures, and cable specifications are also provided.

Timesaver Use the quick reference card that came with your router for quick cabling instructions.

Audience

This publication is designed for the person installing the router, who should be familiar with electronic circuitry and wiring practices and have experience as an electronic or electromechanical technician.

Organization

The major sections of this hardware installation and configuration guide are as follows:

- Chapter 1, “Overview,” discusses the features and specifications of the router, and describes how to obtain technical support and order documentation.
- Chapter 2, “Preparing to Install the Router,” discusses environmental requirements, safety recommendations, and describes the various ports and how to prepare for connections between networks and ports.
- Chapter 3, “Installing the Router,” includes basic installation information and discusses making connections to your LAN, WAN, and console terminal.
- Chapter 4, “Configuring the Cisco Multiport Serial Routers,” discusses configuring the terminal and modems and other asynchronous devices attached to the multiport routers manually using configuration mode, using AutoInstall, or manually using the setup facility.
- Appendix A, “Troubleshooting the Router,” discusses how to isolate problems and read the LEDs.
- Appendix B, “Maintaining the Router,” discusses selected maintenance procedures.
- Appendix C, “Cable Specifications,” provides pinouts for the router ports and cables.

Conventions

This publication uses the following conventions to convey instructions and information.

Command descriptions use these conventions:

- Commands and keywords are in **boldface** font.
- Variables for which you supply values are in *italic* font.
- Elements in square brackets ([ ]) are optional.
- Alternative but required keywords are grouped in braces ({ }) and are separated by vertical bars (|).

Examples use these conventions:

- Terminal sessions and information the system displays are in `screen` font.
- Information you enter is in **`boldface screen`** font.
- Nonprinting characters are in angle brackets (< >).
- Default responses to system prompts are in square brackets ([ ]).

Note Means *reader take note*. Notes contain helpful suggestions or references to materials not contained in this manual.

Timesaver Means *the described action saves time*. You can save time by performing the action described in the paragraph.

Caution Means r*eader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Warning This warning symbol means *danger.* You are in a situation that could cause bodily injury. Before you work on any equipment, you must be aware of the hazards involved with electrical circuitry and familiar with standard practices for preventing accidents. (To see translated versions of this warning, refer to the “Regulatory Compliance and Safety Information” document that accompanied the router.)

CHAPTER 1

Overview of the Router

The Cisco 2520/CPA2520, Cisco 2521/CPA2521, Cisco 2522/CPA2522, and Cisco 2523/CPA2523 routers are full-featured multiport serial routers with synchronous serial, LAN, and asynchronous/synchronous serial ports permitting use as a router or communications server.

Note Throughout this publication, "the router" refers to the Cisco 2520/CPA2520, Cisco 2521/CPA2521, Cisco 2522/CPA2522, and Cisco 2523/CPA2523 routers except when specified otherwise.

Router Hardware Features

The multiport serial routers are available in the following configurations:

Cisco 2520/CPA2520
1 Ethernet port with a selectable attachment unit interface (AUI) connection or 1 Ethernet 10BaseT connection
1 Integrated Services Digital Network (ISDN) Basic Rate Interface (BRI) port (RJ-45)
2 high-speed synchronous serial ports
2 low-speed asynchronous/synchronous serial ports

Cisco 2521/CPA2521
1 Token Ring shielded twisted pair (STP) port or 1 Token Ring unshielded twisted-pair (UTP) port
1 ISDN BRI port (RJ-45)
2 high-speed synchronous serial ports
2 low-speed asynchronous/synchronous serial ports

Cisco 2522/CPA2522 1 Ethernet port with a selectable AUI connection or 1 Ethernet 10BaseT connection
1 ISDN BRI port (RJ-45)
2 high-speed synchronous serial ports
8 low-speed asynchronous/synchronous serial ports

Cisco 2523/CPA2523 1 Token Ring STP port or 1 Token Ring UTP port
1 ISDN BRI port (RJ-45)
2 high-speed synchronous serial ports
8 low-speed asynchronous/synchronous serial ports

Figure 1-1, Figure 1-2, Figure 1-3, and Figure 1-4 shows the rear panels of the Cisco 2520/CPA2520, Cisco 2521/CPA2521, Cisco 2522/CPA2522, and Cisco 2523/CPA2523 routers, respectively.

The multiport serial routers function not only as multiprotocol routers but also as communication servers (see Figure 1-1) for telecommuting services. The multiport serial routers offer high-speed synchronous serial lines for T1 connections, and low-speed asynchronous/synchronous serial lines to attach terminal equipment such as a channel service unit/data service unit (CSU/DSU).

Figure 1-1 through Figure 1-4 show the rear panels of the multiport serial routers.

Figure 1-1 Cisco 2520/CPA2520 Multiport Serial Router—Rear Panel

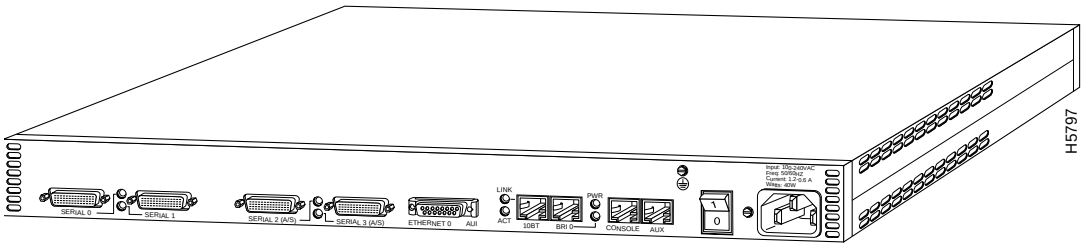


Figure 1-2 Cisco 2521/CPA2521 Multiport Serial Router—Rear Panel

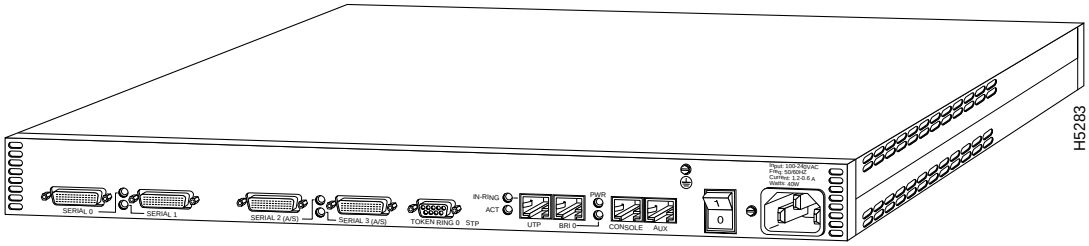


Figure 1-3 Cisco 2522/CPA2522 Multiport Serial Router—Rear Panel

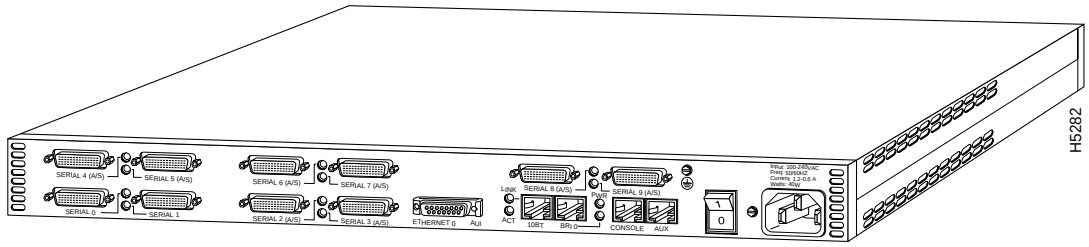
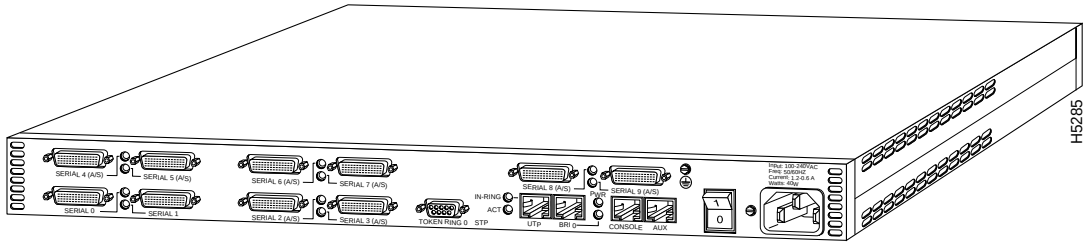


Figure 1-4 Cisco 2523/CPA2523 Multiport Serial Router—Rear Panel



Port Configuration

The asynchronous/synchronous ports are configured as either asynchronous or synchronous. The default is a synchronous port configuration.

Asynchronous/Synchronous Port Features

The low-speed asynchronous/synchronous ports connect terminals, printers, modems, microcomputers, and remote LANs over asynchronous serial lines to an internetwork, or to synchronous devices such as DSU/CSUs on the same ports. The asynchronous/synchronous ports support data transmission rates of up to 115.2 kbps on the following serial interfaces:

- EIA/TIA-232
- EIA/TIA-449
- EIA-530
- V.35
- X.21

Note EIA/TIA-232 and EIA/TIA-449 were known as recommended standards RS-232 and RS-449 before their acceptance as standards by the Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA).

The multiport serial routers support numerous protocols. The following are examples of some of the low-speed synchronous and asynchronous protocols:

- Autobaud
- Bisync
- Frame Relay
- Half-duplex operation
- HDLC

- PPP
- SDLC
- X.25

Communications Server Services

The multiport router acts as a communications server to connect terminals, printers, modems, microcomputers, and remote LANs over asynchronous serial lines to an internetwork. The communications server uses a set of connection services to allow remote networks access to an internetwork of LANs and WANs.

The router supports four types of server operation:

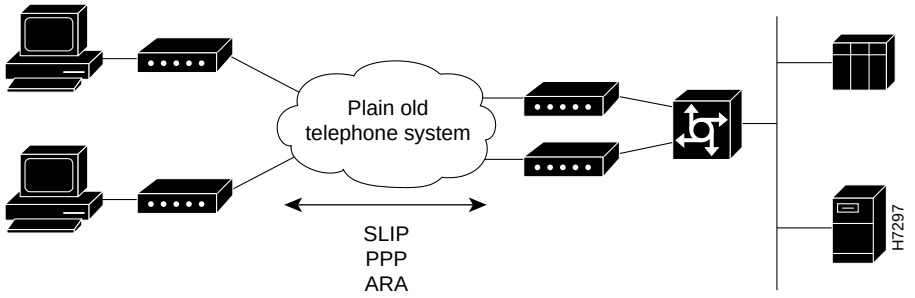
- Remote node services
- Terminal services
- Asynchronous routing services
- Protocol translation services

Remote Node Services

Remote node services support remote network connectivity with Serial Line Internet Protocol (SLIP), Point-to-Point Protocol (PPP), or AppleTalk Remote Access Protocol (ARA protocol).

Single users with laptop or desktop computing devices can access corporate data and many other resources on the Internet using dialup lines. Figure 1-5 shows an example network.

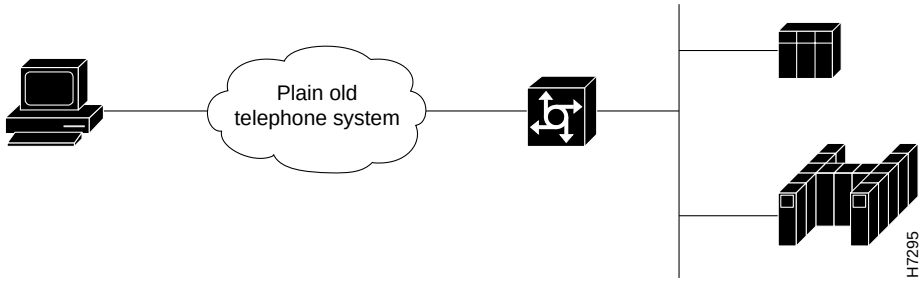
Figure 1-5 Remote Node Services—Example Network



Terminal Services

Terminal services provide terminal-to-host connectivity with virtual terminal protocols including Telnet, rlogin, local-area transport (LAT), TN3270, and X.25 packet assembler/disassembler (PAD). Terminal services can be used to connect to a modem in a modem pool for outbound connectivity. Figure 1-6 shows an example network.

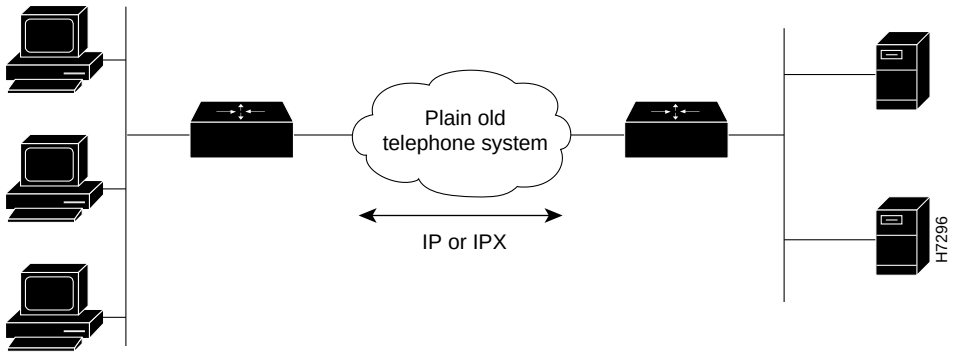
Figure 1-6 Terminal Services—Example Network



Asynchronous Routing Services

Routing services enable the multiport router to route packets over LANs and WANs using the asynchronous interfaces. A key benefit of asynchronous routing is that it provides low-cost operation by using dialup telephone networks only when needed. Figure 1-7 shows an example network.

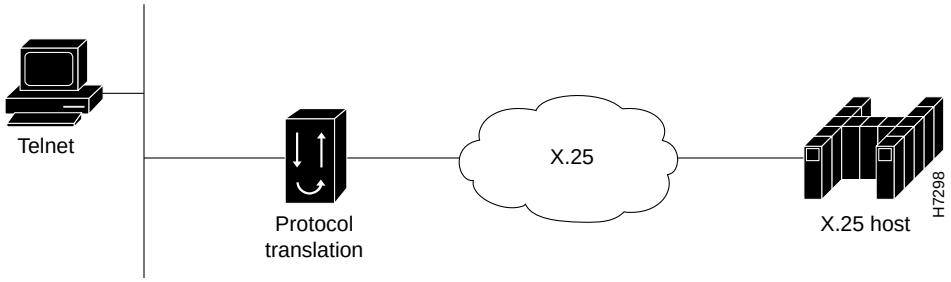
Figure 1-7 Asynchronous Routing—Example Network



Protocol Translation Services

Protocol translation allows terminal services running over one protocol to be translated to terminal services running over another protocol such as an X.25 packet PAD to Telnet (using Transmission Control Protocol/Internet Protocol [TCP/IP]). Protocol translation on the multiport router supports Telnet, TN3270, LAT, and X.25 PAD. Figure 1-8 shows an example network.

Figure 1-8 Protocol Translation Services—Example Network



System Specifications

The system specifications of the Cisco 2500 series multiport routers are listed in Table 1-1.

Table 1-1 System Specifications

Description	Specification
Dimensions (H x W x D)	1.75 x 17.5 x 10.56 inches (one rack unit) (4.44 x 44.45 x 26.82 cm)
Weight	10 lb (4.5 kg)
Input voltage, AC power supply Current Frequency Power dissipation	100 to 240 VAC 0.6 to 1.2A 50 to 60 Hz 40W (maximum), 135.5 Btus[1]/hr
Input voltage, DC power supply Current Power dissipation	– 40 to –72 VDC 1.5 to 1.0A 40W (maximum), 135.5 Btus/hr
Processor	20-MHz Motorola 68EC030

Description	Specification
Network interface options	model 2520: • 1 Ethernet (AUI or 10BaseT), 1 ISDN BRI port, 2 synchronous serial, 2 asynchronous/ synchronous serial model 2521: • 1 Token Ring (DB-9 or UTP), 1 ISDN BRI port, 2 synchronous serial, 2 asynchronous/ synchronous serial model 2522: • 1 Ethernet (AUI or 10BaseT), 1 ISDN BRI port, 2 synchronous serial, 8 asynchronous/ synchronous serial model 2523: • 1 Token Ring (DB-9 or UTP), 1 ISDN BRI port, 2 synchronous serial, 8 asynchronous/ synchronous serial
Operating environment	32 to 104°F (0 to 40°C)
Nonoperating temperature	–40 to 185°F (–40 to 85°C)
Operating humidity	5 to 95%, noncondensing
Noise level	34 dBa @ 3' (0.914 m)
Regulatory Compliance	FCC Class A. For more regulatory information, refer to the *Regulatory Compliance and Safety Information* document that accompanied you router.

1. BTU = British thermal unit.

Obtaining Service and Support

For service and support for a product purchased from a reseller, contact the reseller. Resellers offer a wide variety of Cisco service and support programs, which are described in the information packet that shipped with your chassis.

If you purchased your product from a reseller, you can access Cisco Connection Online (CCO) as a guest. CCO is Cisco Systems' primary, real-time support channel.Your reseller offers programs that include direct access to CCO's services.

For service and support for a product purchased directly from Cisco, use CCO.

Cisco Connection Online

CCO is Cisco Systems' primary, real-time support channel. SMARTnet customers and partners can self-register on CCO to obtain additional content and services.

Available 24 hours a day, 7 days a week, CCO provides a wealth of standard and value-added services to Cisco's customers and business partners. CCO services include product information, software updates, release notes, technical tips, the Bug Navigator, configuration notes, brochures, descriptions of service offerings, and download access to public and authorized files.

CCO serves a wide variety of users through two interfaces that are updated and enhanced simultaneously-a character-based version and a multimedia version that resides on the World Wide Web (WWW). The character-based CCO supports Zmodem, Kermit, Xmodem, FTP, and Internet e-mail, and is excellent for quick access to information over lower bandwidths. The WWW version of CCO provides richly formatted documents with photographs, figures, graphics, and video, as well as hyperlinks to related information.

You can access CCO in the following ways:

- WWW: http://www.cisco.com.
- WWW: http://www-europe.cisco.com.
- WWW: http://www-china.cisco.com.
- Telnet: cco.cisco.com.
- Modem: From North America, 408 526-8070; from Europe, 33 1 64 46 40 82.

  Use the following terminal settings: VT100 emulation; databits: 8; parity: none; stop bits: 1; and baud rates up to 14.4 kbps.

For a copy of CCO's Frequently Asked Questions (FAQ), contact ccohelp@cisco.com. For additional information, contact ccoteam@cisco.com.

If you need technical assistance with a Cisco product that is under warranty or covered by a Cisco maintenance contract, contact Cisco's Technical Assistance Center (TAC) at 800 553-2447, 408 526-7209, or tac@cisco.com.

Please use CCO to obtain general information about Cisco Systems, Cisco products, or upgrades. If CCO is not accessible, contact 800 553-6387, 408 526-7208, or csrep@cisco.com.

Ordering Documentation

Documentation for Cisco products is available in three forms: on a CD-ROM, printed books, and on the World Wide Web. You have the option of subscribing to the documentation CD through an update service. Or you can order printed documentation at an additional cost. Refer to the information packet included with the router for detailed ordering information. You can also access Cisco documentation on the World Wide Web URL http://www.cisco.com.

CHAPTER 2

Preparing to Install the Router

This chapter describes important information to consider before you begin to install the router, and includes the following sections:

- Safety Recommendations
- General Site Requirements
- Preparing to Connect to a Network
- Preparing to Connect to a Network
- Inspecting the System

Safety Recommendations

Follow these guidelines to ensure general safety:

- Keep the chassis area clear and dust-free during and after installation.
- Put the removed chassis cover in a safe place.
- Keep tools away from walk areas where you and others could fall over them.
- Do not wear loose clothing that could get caught in the chassis. Fasten your tie or scarf and roll up your sleeves.
- Wear safety glasses if you are working under any conditions that might be hazardous to your eyes.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe.

Warning Ultimate disposal of this product should be handled according to all national laws and regulations. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Maintaining Safety with Electricity

Follow these guidelines when working on equipment powered by electricity.

Warning Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or can weld the metal object to the terminals. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

- Locate the emergency power OFF switch for the room in which you are working. Then, if an electrical accident occurs, you can act quickly to turn OFF the power.
- Power OFF the router and unplug the power cord before doing the following:
  - Installing or removing a chassis
  - Working near power supplies

Warning Before working on a chassis or working near power supplies, unplug the power cord on AC units; disconnect the power at the circuit breaker on DC units. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Warning Do not touch the power supply when the power cord is connected. For systems with a power switch, line voltages are present within the power supply even when the power switch is OFF and the power cord is connected. For systems without a power switch, line voltages are present within the power supply when the power cord is connected. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

- Do not work alone if potentially hazardous conditions exist.
- Never assume that power is disconnected from a circuit. Always check.

Warning Read the installation instructions before you connect the system to its power source. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

- Look carefully for possible hazards in your work area, such as moist floors, ungrounded power extension cables, frayed power cords, and missing safety grounds.
- If an electrical accident occurs, proceed as follows:
  - Use caution; do not become a victim yourself.
  - Turn OFF power to the system.
  - If possible, send another person to get medical aid. Otherwise, assess the condition of the victim and then call for help.
  - Determine if the person needs rescue breathing or external cardiac compressions; then take appropriate action.

Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) can damage equipment and impair electrical circuitry. It occurs when electronic components are improperly handled and can result in complete or intermittent failures.

Always follow ESD-prevention procedures when removing and replacing components. Ensure that the chassis is electrically connected to earth ground. Wear an ESD-preventive wrist strap, ensuring that it makes good skin contact. Connect the clip to an unpainted surface of the chassis frame to safely channel unwanted ESD voltages to ground. To properly guard against ESD damage and shocks, the wrist strap and cord must operate effectively. If no wrist strap is available, ground yourself by touching the metal part of the chassis.

Caution For safety, periodically check the resistance value of the antistatic strap, which should be between 1 to 10 megohms (Mohms).

General Site Requirements

This section describes the requirements your site must meet for safe installation and operation of your system. Ensure that your site is properly prepared before beginning installation.

Site Environment

The router can be placed on a desktop or mounted in a rack or on a wall. The location of the chassis and the layout of your equipment rack or wiring room are extremely important for proper system operation. Equipment placed too close together, inadequate ventilation, and inaccessible panels can cause system malfunctions and shutdowns, and can make system maintenance difficult.

When planning your site layout and equipment locations, remember the precautions described in the next section, “Preventive Site Configuration” to help avoid equipment failures and reduce the possibility of environmentally caused shutdowns. If you are experiencing shutdowns or unusually high errors with your existing equipment, these precautions may help you isolate the cause of failures and prevent future problems.

Preventive Site Configuration

The following precautions will help you plan an acceptable operating environment for your router and will help you avoid environmentally caused equipment failures.

- Electrical equipment generates heat. Ambient air temperature might not be adequate to cool equipment to acceptable operating temperatures without adequate circulation. Ensure that the room in which you operate your system has adequate air circulation.
- Always follow the ESD-prevention procedures described in the section “Preventing Electrostatic Discharge Damage” earlier in this chapter to avoid damage to equipment. Damage from static discharge can cause immediate or intermittent equipment failure.
- Ensure that the chassis cover is secure. The chassis is designed to allow cooling air to flow effectively within it. An open chassis allows air leaks, which may interrupt and redirect the flow of cooling air from internal components.

Configuring Equipment Racks

The following information will help you plan an acceptable equipment rack configuration.

- Enclosed racks must have adequate ventilation. Ensure that the rack is not overly congested because each unit generates heat. An enclosed rack should have louvered sides and a fan to provide cooling air.
- When mounting a chassis in an open rack, ensure that the rack frame does not block the intake or the exhaust ports. If the chassis is installed on slides, check the position of the chassis when it is seated all the way into the rack.
- In an enclosed rack with a ventilation fan in the top, excessive heat generated by equipment near the bottom of the rack can be drawn upward and into the intake ports of the equipment above it in the rack. Ensure that you provide adequate ventilation for equipment at the bottom of the rack.
- Baffles can help to isolate exhaust air from intake air, which also helps to draw cooling air through the chassis. The best placement of the baffles depends on the airflow patterns in the rack, which are found by experimenting with different arrangements.

Power Supply Considerations

Check the power at your site to ensure that you are receiving "clean" power (free of spikes and noise). Install a power conditioner if necessary.

Warning The device is designed to work with TN power systems. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

The router power supply includes the following features:

- Autoselects either 110V or 220V operation.
- All units include a 6-foot (1.8-meter) electrical power cord. (A label near the power cord indicates the correct voltage, frequency, current draw, and power dissipation for the unit.)

Warning This product relies on the building's installation for short-circuit (overcurrent) protection. Ensure that a fuse or circuit breaker no larger than 120 VAC, 15A U.S. (240 VAC, 10A international) is used on the phase conductors (all current-carrying conductors). (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

If you encounter trouble with your power supply, refer to the section "Troubleshooting the Power and Cooling Systems" in the appendix "Troubleshooting the Router."

Preparing to Connect to a Network

When setting up your router, consider distance limitations and potential electromagnetic interference (EMI) as defined by the EIA.

Warning The ports labeled “Ethernet,” “10BaseT,” “Token Ring,” “Console,” and “AUX” are safety extra-low voltage (SELV) circuits. SELV circuits should only be connected to other SELV circuits. Because the BRI circuits are treated like telephone-network voltage, avoid connecting the SELV circuit to the telephone network voltage (TNV) circuits. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

For additional information on connecting your ports, cables and network connections, refer to the section “Troubleshooting the Ports, Cables, and Connections” in the appendix “Troubleshooting the Router.”

Synchronous Serial Connections

Before you connect a device to the synchronous serial port (labeled “SERIAL”), you will need to know the following:

- The type of device, DTE or DCE, you are connecting to the synchronous serial interface.
- The type of connector, male or female, required to connect to the device.
- The signaling standard required by the device.

DTE or DCE

A device that communicates over a synchronous serial interface is either a DTE or DCE device. A DCE device provides a clock signal that paces the communications between the device and the router. A DTE device does not provide a clock signal. DTE devices usually connect to DCE devices. The documentation that came with the communications device should indicate whether it is a DTE or DCE device. (Some devices have a jumper to select either mode.) If you cannot find the information in the documentation, refer to to help you select the proper device type.

Table 2-1 Typical DTE and DCE Devices

Device Type	Gender	Typical Devices
DTE	Male[1]	Terminal
		PC
		Router
DCE	Female[2]	Modem
		CSU/DSU[3]
		Multiplexer

1. If pins protrude from the base of the connector, the connector is male.
2. If the connector has holes to accept pins, the connector is female.
3. CSU/DSU = Channel service unit/data service unit.

Speed and Distance Limitations

Serial signals can travel a limited distance at any given bit rate; generally, the slower the data rate, the greater the distance. All serial signals are subject to distance limits, beyond which a signal degrades significantly or is completely lost.

Table 2-2 lists the maximum speeds and distances for EIA/TIA-232 signals. This signaling standard supports unbalanced circuits at signal speeds up to 64 kbps.

Table 2-2 EIA/TIA-232 Speed and Distance Limitations

Data Rate (Baud)	Distance (Feet)	Distance (Meters)
2400	200	60
4800	100	30
9600	50	15
19200	50	15
38400	50	15
64000	25	7.6

Balanced drivers allow EIA/TIA-449 signals to travel greater distances than the EIA/TIA-232 signals. Table 2-3 lists the maximum speeds and distances for EIA/TIA-449, which are also valid for V.35, X.21, and EIA-530 signals.

Table 2-3 EIA/TIA-449, V.35, X.21, and EIA-530 Speed and Distance Limitations

Data Rate (Baud)	Distance (Feet)	Distance (Meters)
2400	4,100	1,250
4800	2,050	625
9600	1,025	312
19200	513	156
38400	256	78
56000	102	31

Caution The EIA/TIA-449 and V.35 interfaces support data rates up to 2.048 Mbps. Exceeding this maximum could result in loss of data and is not recommended.

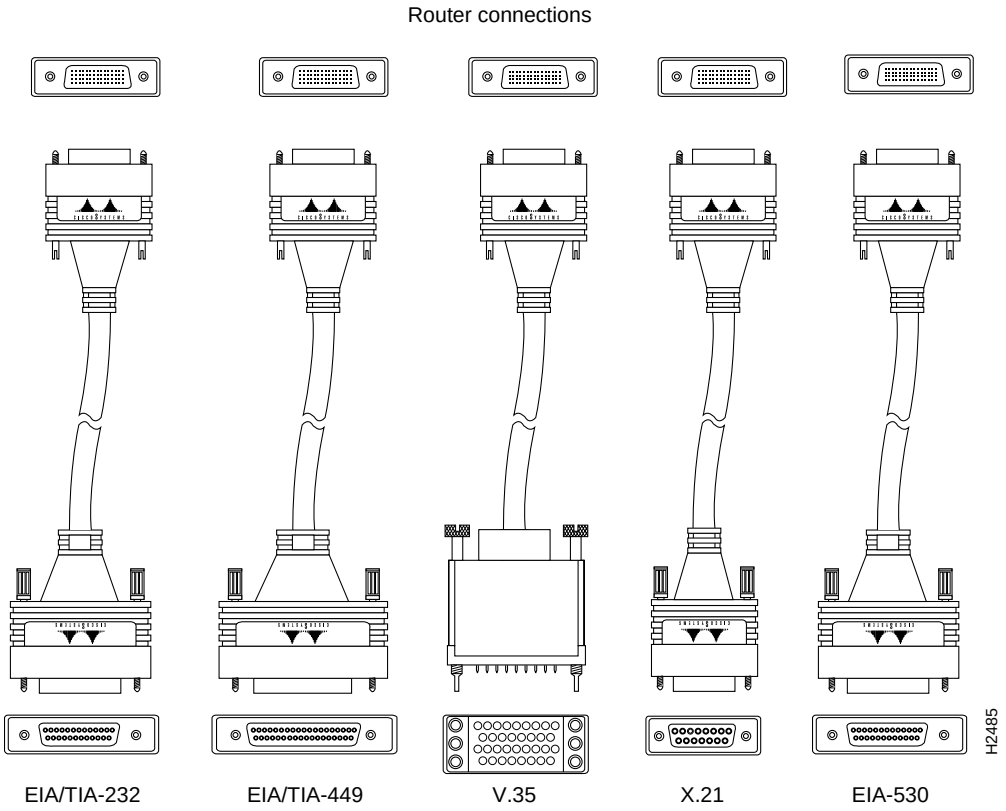
Signaling Standards

The synchronous serial port supports the following signaling standards: EIA/TIA-232, EIA/TIA-449, V.35, X.21, and EIA-530. You can order a DB-60 shielded serial transition cable that has the appropriate connector for the standard you specify. The router end of the shielded serial transition cable has a DB-60 connector, which connects to the serial port on the rear panel of the router. The other end of the serial transition cable is available with the connector appropriate for the standard you specify. The documentation for the device you want to connect should indicate the standard used for that device. The synchronous serial port can be configured as DTE or DCE (except EIA-530, which is DTE only), depending on the attached cable.

Note All serial ports configured as DTE require external clocking from a CSU/DSU or other DCE device.

Figure 2-1 shows the serial transition cables you can connect to the serial port on the rear panel of the router.

Figure 2-1 Serial Transition Cables



Although attempting to manufacture your own serial cables is not recommended (because of the small size of the pins on the DB-60 serial connector), cable pinouts are provided in the appendix “Cable Specifications.” To order a cable, see the section “Obtaining Service and Support” in the “Overview of the Router” chapter.

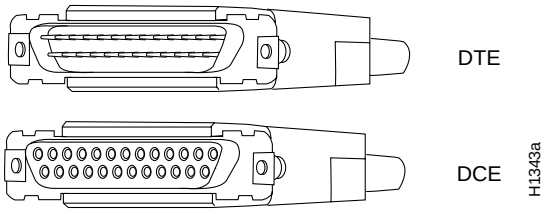
EIA/TIA-232 Connections

The EIA/TIA-232 standard supports unbalanced circuits at signal speeds up to 64 kbps. The serial port (labeled “SERIAL”) supports *synchronous* connections. The console and auxiliary ports also use an EIA/TIA-232 connection; however, the console and auxiliary ports support *asynchronous* connections.

The network end of the EIA/TIA-232 serial transition cable (not included) provides a DB-25 connector, as shown in Figure 2-2. The end that connects to the serial port on the rear panel of the router has a DB-60 connector.

EIA/TIA-232 serial transition cables are available with a DB-25 connected in either DTE or DCE mode. To order a cable, see the section “Obtaining Service and Support” in the “Overview of the Router” chapter.

Figure 2-2 EIA/TIA-232 Serial Transition Cable Connectors, Network End



EIA/TIA-449 Connections

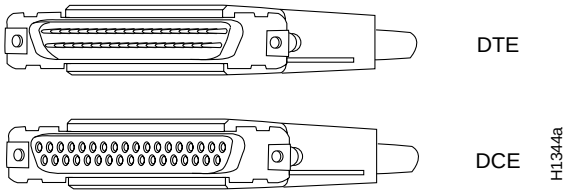
The EIA/TIA-449 standard, which supports balanced and unbalanced transmissions, is a faster (up to 2 Mbps) version of the EIA/TIA-232 standard that provides more functions and supports transmissions over greater distances.

The EIA/TIA-449 standard was intended to replace the EIA/TIA-232 standard, but it was not widely adopted primarily because of the large installed base of DB-25 hardware and because of the larger size of the 37-pin EIA/TIA-449 connectors, which limited the number of connections possible (fewer than possible with the smaller, 25-pin EIA/TIA-232 connector).

The network end of the EIA/TIA-449 serial transition cable (not included) provides a DB-37 connector, as shown in Figure 2-3. The end that connects to the serial port on the rear panel of the router has a DB-60 connector.

EIA/TIA-449 serial transition cables are available with a DB-37 connected in either DTE or DCE mode. To order a cable, see the section “Obtaining Service and Support” in the “Overview of the Router” chapter.

Figure 2-3 EIA/TIA-449 Serial Transition Cable Connectors, Network End

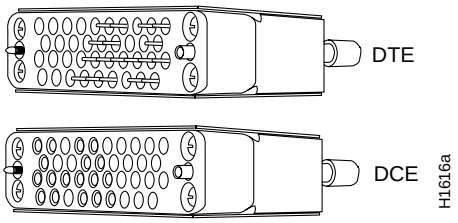


V.35 Connections

The V.35 standard is recommended for speeds up to 48 kbps, although in practice it is used successfully at 4 Mbps.

The network end of the V.35 serial transition cable (not included) provides a standard 34-pin Winchester-type connector, as shown in Figure 2-4. The end that connects to the serial port on the rear panel of the router has a DB-60 connector. V.35 cables are available with a standard V.35 plug or receptacle in either DTE or DCE mode. To order a cable, see the section “Obtaining Service and Support” in the “Overview of the Router” chapter.

Figure 2-4 V.35 Serial Transition Cable Connectors, Network End

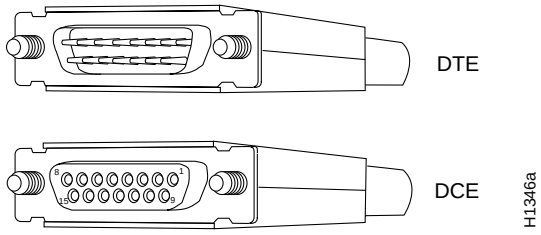


X.21 Connections

The X.21 connector uses a 15-pin connector for balanced circuits and is commonly used in the United Kingdom to connect to the public data network. X.21 relocates some of the logic functions to the DTE and DCE interfaces and, as a result, requires fewer circuits and a smaller connector than EIA/TIA-232.

The network end of the X.21 serial transition cable (not included) is a standard DB-15 connector, as shown in Figure 2-5. The end that connects to the serial port on the rear panel of the router has a DB-60 connector. X.21 cables are available with a plug or receptacle in either DTE or DCE mode. To order a cable, see the section “Obtaining Service and Support” in the “Overview of the Router” chapter.

Figure 2-5 X.21 Serial Transition Cable Connectors, Network End

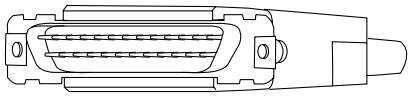


EIA-530 Connections

The EIA-530 standard, which supports balanced transmission, provides the increased functionality, speed, and distance of EIA/TIA-449 on the smaller, DB-25 connector used for EIA/TIA-232, instead of the 37-pin connector used for EIA/TIA-449. Like EIA-TIA-449, EIA-530 refers to the electrical specifications of EIA/TIA-422 and EIA/TIA-423. Although the specification recommends a maximum speed of 2 Mbps, EIA-530 is used successfully at 4 Mbps or faster speeds over short distances.

The EIA-530 serial transition cable (not included) is available in DTE mode only. The network end of the EIA-530 adapter cable is a standard DB-25 plug commonly used for EIA/TIA-232 connections, as shown in Figure 2-6. The end that connects to the serial port on the rear panel of the router has a DB-60 connector. To order a cable, see the section "Obtaining Service and Support" in the "Overview of the Router" chapter.

Figure 2-6 EIA-530 Serial Transition Cable Connector, Network End



Asynchronous/Synchronous Serial Connections

The asynchronous/synchronous serial ports use the asynchronous/synchronous 60-pin connectors located on the rear panel. The lower ports are labeled SERIAL 2 (A/S) and SERIAL 3 (A/S): the upper ports (depending on which chassis you have) are labeled SERIAL 4 (A/S) through SERIAL 9 (A/S).

You must use a special serial cable to connect a multiport serial router to a modem or CSU/DSU. The cable uses a DB-60 connector on the chassis end. See the appendix "Cable Specifications" for cable pinouts. To order a cable, see the section "Obtaining Service and Support" in the "Overview of the Router" chapter.

Ethernet Connections

The IEEE has established Ethernet as standard 802.3. The most common Ethernet implementations are as follows:

- 10Base5 (AUI)—Ethernet on thick coaxial cable, also known as thick Ethernet. The maximum segment distance is 1,640 feet (500 meters).
- 10Base2 (Thinnet)—Ethernet on thin coaxial cable, also known as thin Ethernet. The maximum segment distance is 607 feet (185 meters).
- 10BaseT—Ethernet on unshielded twisted-pair (UTP) cable. The maximum segment distance is 328 feet (100 meters). UTP cables look like the cables used for ordinary telephones; however, UTP cables meet certain electrical standards that telephone cables do not.

Your router includes an Ethernet AUI interface and a 10BaseT interface, which operates at speeds up to 10 Mbps.

The cables and transceivers required to connect the router to an Ethernet network are not included. For ordering information, see the section “Obtaining Service and Support” in the “Overview of the Router” chapter.

Token Ring Connections

The two Token Ring ports are located on the rear panel of the Cisco 2521 and Cisco 2523 and are labeled TOKEN RING or UTP. The port labeled TOKEN RING uses a standard 9-pin Token Ring lobe cable and connects the multiport serial router directly to a media attachment unit (MAU). The Token Ring port labeled UTP uses an RJ-45 Token Ring cable and is connected through an adapter or directly to a MAU. Only one Token Ring port can be used at a time.

BRI Connections

On models with a Basic Rate Interface (BRI) port, the BRI port is an RJ-45 8-pin connector located between the UTP and console ports on the Cisco 2520 and Cisco 2521, or between the 10BT and console ports on the Cisco 2522 and Cisco 2523. Use an appropriate cable to connect the system directly to the Integrated Services Digital Network (ISDN) through the NT1. The common carrier will provide the NT1 connection worldwide, except in North America, where the NT1 is customer owned.

Warning Network hazardous voltages are accessible in the BRI cable. If you detach the BRI cable, detach the end away from the multiport serial router first to avoid possible electric shock. Network hazardous voltages also are accessible on the system card in the area of the BRI port (RJ-45 connector), regardless of whether power is turned off. (To see translated versions of this warning, refer to the "*Regulatory Compliance and Safety Information*" publication.)

Warning The ISDN connection is regarded as a source of voltage that should be inaccessible to user contact. Do not attempt to tamper with or open any public telephone operator (PTO)-provided equipment or connection hardware. Any hardwired connection (other than by nonremovable, connect-one-time-only lug) must be made only by PTO staff or suitably trained engineers. (To see translated versions of this warning, refer to the "*Regulatory Compliance and Safety Information*" publication.)

Console and Auxiliary Port Connections

Your router includes an asynchronous serial console and an auxiliary port. The console and auxiliary ports provide access to the router either locally (with a console terminal) or remotely (with a modem). This section discusses important cabling information to consider before connecting a console terminal (an ASCII terminal or PC running terminal emulation software) to the console port or modem to the auxiliary port.

The main difference between the console and auxiliary ports is that the auxiliary port supports hardware flow control and the console port does not. Flow control paces the transmission of data between a sending device and a receiving device. Flow control ensures that the receiving device can absorb the data sent to it before the sending device sends more. When the buffers on the receiving device are full, a message is sent to the sending device to suspend transmission until the data in the buffers has been processed. Because the auxiliary port supports flow control, it is ideal for use with the high-speed transmissions of a modem. Console terminals transmit at slower speeds than modems; therefore, the console port is ideal for use with console terminals.

Console Port Connections

Your router includes an EIA/TIA-232 asynchronous serial console port (RJ-45). Cables and adapters to connect a console terminal (an ASCII terminal or PC running terminal emulation software) to the console port are included. To connect an ASCII terminal to the console port, use the RJ-45-to-RJ-45 roll-over cable (looks like a telephone cable) with the female RJ-45-to-DB-25 adapter (labeled “TERMINAL”). To connect a PC running terminal emulation software to the console port, use the RJ-45-to-RJ-45 roll-over cable with the female RJ-45-to-DB-9 adapter (labeled “TERMINAL”). The default parameters for the console port are 9600 baud, 8 data bits, no parity, and 2 stop bits. The console port does not support hardware flow control. For detailed information about installing a console terminal, see the section “Connecting to the Console Port” in the chapter “Installing the Router.” See the appendix “Cable Specifications” for cable and port pinouts.

Auxiliary Port Connections

Your router includes an EIA/TIA-232 asynchronous serial auxiliary port (RJ-45) that supports hardware flow control. A cable and an adapter to connect a modem to the auxiliary port are included. To connect a modem to the auxiliary port, use the RJ-45-to-RJ-45 roll-over cable (looks like a telephone cable) with the male RJ-45-to-DB-25 adapter (labeled “MODEM”). For detailed information about connecting devices to the auxiliary port, see the section “Connecting a Modem to the Auxiliary Port” in the chapter “Installing the Router.” See the appendix “Cable Specifications” for cable and port pinouts.

Inspecting the System

Do not unpack the router until you are ready to install it. If the final installation site will not be ready for some time, keep the chassis in its shipping container to prevent accidental damage. When you have determined where you want the router installed, proceed with unpacking it, and continue using the chapter “Installing the Router.”

CHAPTER 3

Installing the Router

This chapter describes the tasks you must perform to install the router, and includes the following sections:

- Tools and Equipment Required
- Setting Up the Chassis
- Connecting the DC Power Supply
- Connecting the Console Terminal and Modem
- What to Do after Installing the Router Hardware

Tools and Equipment Required

Installation requires some tools and equipment that are not included as standard equipment with the router. Following are the tools and equipment required to install the router, which are not included:

- Flat-blade screwdrivers: small, 3/16-inch (0.476 cm) and medium, 1/4-inch (0.625 cm)
- ESD-preventive wrist strap
- Screws to secure the rack-mount brackets to the router
- Cables for connection to the WAN and LAN ports:
  - RJ-45-to-RJ-45 roll-over cables for connection to the asynchronous serial ports.
  - Ethernet AUI cable or Ethernet transceiver for connection to the Ethernet AUI port.
  - Serial transition cable for connection to the synchronous serial port.

Note For cable ordering information, see the section "Obtaining Service and Support" in the "Overview of the Router" chapter.

- Ethernet 10BaseT hub or PC with a network interface card for connection to the Ethernet AUI (LAN) port.
- Token Ring Media Attachment Unit (MAU) for connection to the Token Ring port.
- CSU/DSU or other DCE device for connection to the synchronous serial interface.
- Console terminal (an ASCII terminal or a PC running terminal emulation software) configured for 9600 baud, 8 data bits, no parity, and 2 stop bits. A terminal is required unless you are using the AutoInstall procedure. See the section "Connecting the Console Terminal and Modem" later in this chapter for instructions on connecting a console terminal.
- Modems for connection to the asynchronous serial ports.

Setting Up the Chassis

You can set the chassis on a desktop, install it in a rack, or mount it on a wall or other flat surface. Use the procedure in this section that best meets the needs of your network. The sections are as follows:

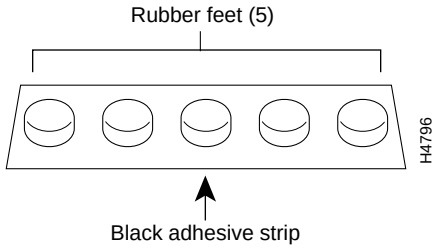
- Setting the Chassis on a Desktop
- Rack-Mounting the Chassis
- Wall-Mounting the Chassis

Setting the Chassis on a Desktop

Before setting the chassis on a desktop, shelf, or other flat, secure surface, perform the following steps to install the rubber feet:

Step 1 Locate the rubber feet on the black adhesive strip that shipped with the chassis. (See Figure 3-1.)

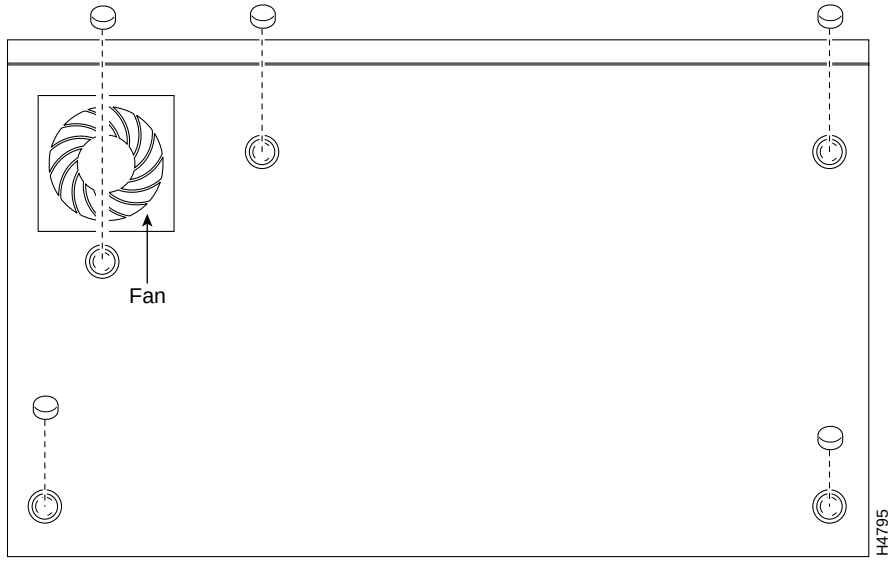
Figure 3-1 Identifying the Rubber Feet



Step 2 Place the chassis upside down on a smooth, flat surface.

Step 3 Peel off the rubber feet from the black adhesive strip and place them adhesive-side down onto the five round, recessed areas on the bottom of the chassis, as shown in Figure 3-2.

Figure 3-2 Installing the Rubber Feet



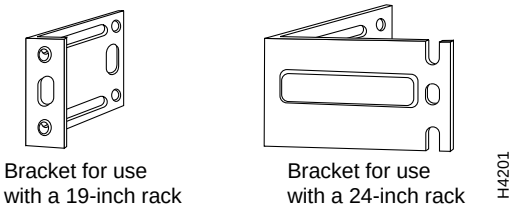
Step 4 Place the router right-side up on a flat, smooth, secure surface.

Caution Do not place anything on top of the router that weighs more than 10 pounds (4.5 kg). Excessive weight on top could damage the chassis.

Rack-Mounting the Chassis

This section describes the procedures for rack-mounting the chassis. The chassis comes with brackets for use with a 19-inch rack or, if specified in your order, optional larger brackets for use with a 24-inch rack. The brackets are shown in Figure 3-3.

Figure 3-3 Identifying the Brackets



Attaching the Brackets

To install the chassis in a rack, attach the brackets in one of the following ways:

- With the front panel forward (see Figure 3-4)
- With the rear panel forward (see Figure 3-5)
- In a center-mount telco rack (see Figure 3-6)

Note The illustrations that follow show how to connect a bracket to one side of the chassis. The second bracket connects to the opposite side of the chassis.

Figure 3-4 Bracket Installation—Front Panel Forward

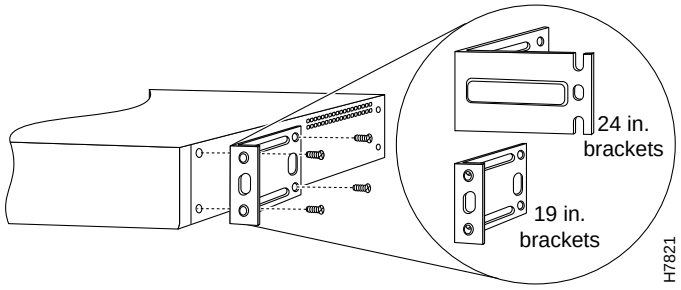


Figure 3-5 Bracket Installation—Rear Panel Forward

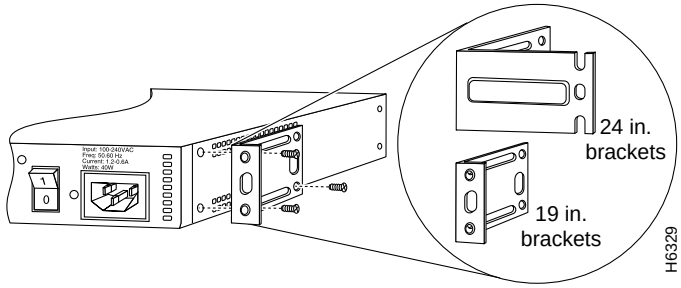
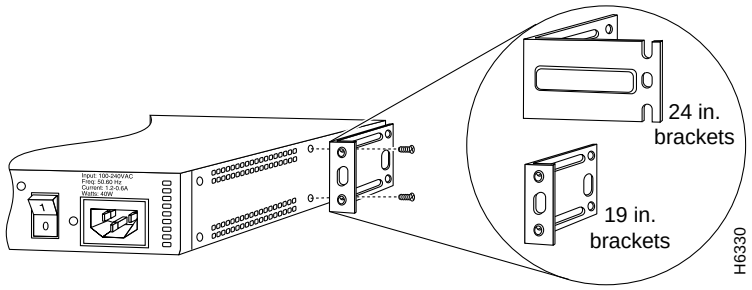


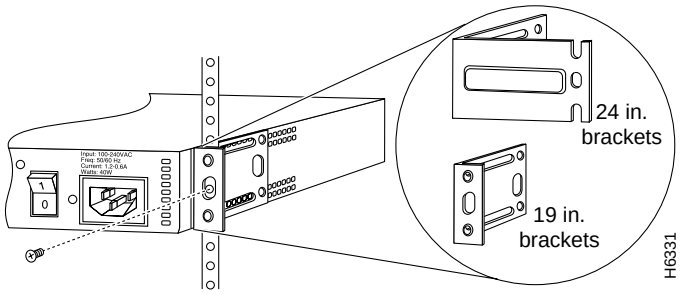
Figure 3-6 Telco Bracket Installation—Rear Panel Forward



Installing in a Rack

After the brackets are secured to the chassis, you can rack-mount it. Using the screws you provide, attach the chassis to the rack as shown in Figure 3-7.

Figure 3-7 Attaching the Chassis to a Rack—Rear Panel Forward



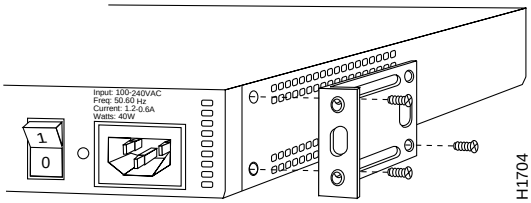
Wall-Mounting the Chassis

Use the smaller brackets (for use with a 19-inch rack) to wall-mount the chassis. The smaller brackets provide the most stable position for the chassis.

Take the following steps to wall-mount the chassis:

Step 1 Attach the brackets as shown in Figure 3-8.

Figure 3-8 Attaching the Wall-Mount Brackets

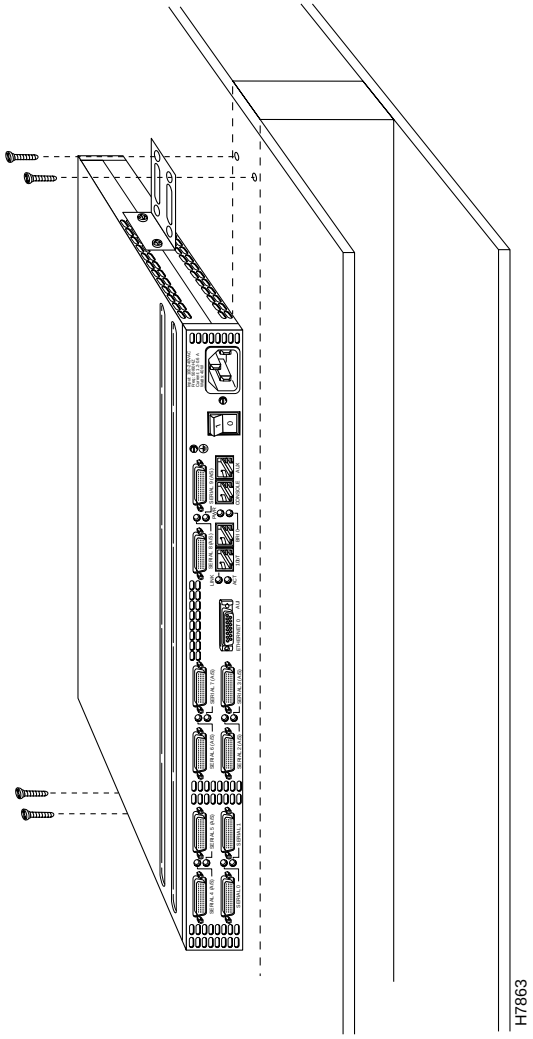


Note: The second bracket attaches to the other side of the chassis.

Step 2 Attach the chassis assembly to the wall as shown in Figure 3-9, using screws and anchors that you provide. We recommend the following:

- For the best support of the chassis and cables, attach the brackets so that the screws align with a vertical wall stud. (See Figure 3-9.) This position will prevent the chassis from pulling away from the wall when cables are attached.
- For the best ventilation of the chassis, mount the chassis with the power supply and fan at the top. Make sure there is clearance between the router and the wall.

Figure 3-9 Wall-Mounting the Chassis



Connecting the DC Power Supply

The multiport serial router has an optional direct current (DC) power supply. This section describes the DC power supply specifications and wiring.

DC Power Specifications

The DC power supply is intended for use in DC operating environments. Table 3-1 lists the power supply specifications.

Table 3-1 DC Power Supply Specifications

Description	Design Specification
Power	40W, –40 to –72 VDC
Wire gauge for power connections	14 AWG[1]

1. AWG = American wire gauge.

Wiring the DC Power Supply

If you ordered a multiport serial router with a DC power supply, follow the directions in this section for proper wiring.

Warning Only trained and qualified personnel should be allowed to install or replace this equipment. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Warning Before performing any of the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the off position, and tape the switch handle of the circuit breaker in the off position. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Warning This unit is intended for installation in restricted access areas. A restricted access area is where access can only be gained by service personnel through the use of a special tool, lock and key, or other means of security, and is controlled by the authority responsible for the location. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Note This product is intended for installation in areas with restricted access and is approved for use with copper conductors only. The installation must comply with all applicable codes.

Figure 3-10 shows the DC power supply terminal block. Take the following steps to wire the terminal block:

Step 1 Attach the appropriate lugs at the wire end of the power supply cord.

Step 2 Wire the DC power supply to the terminal block as shown in Figure 3-10.

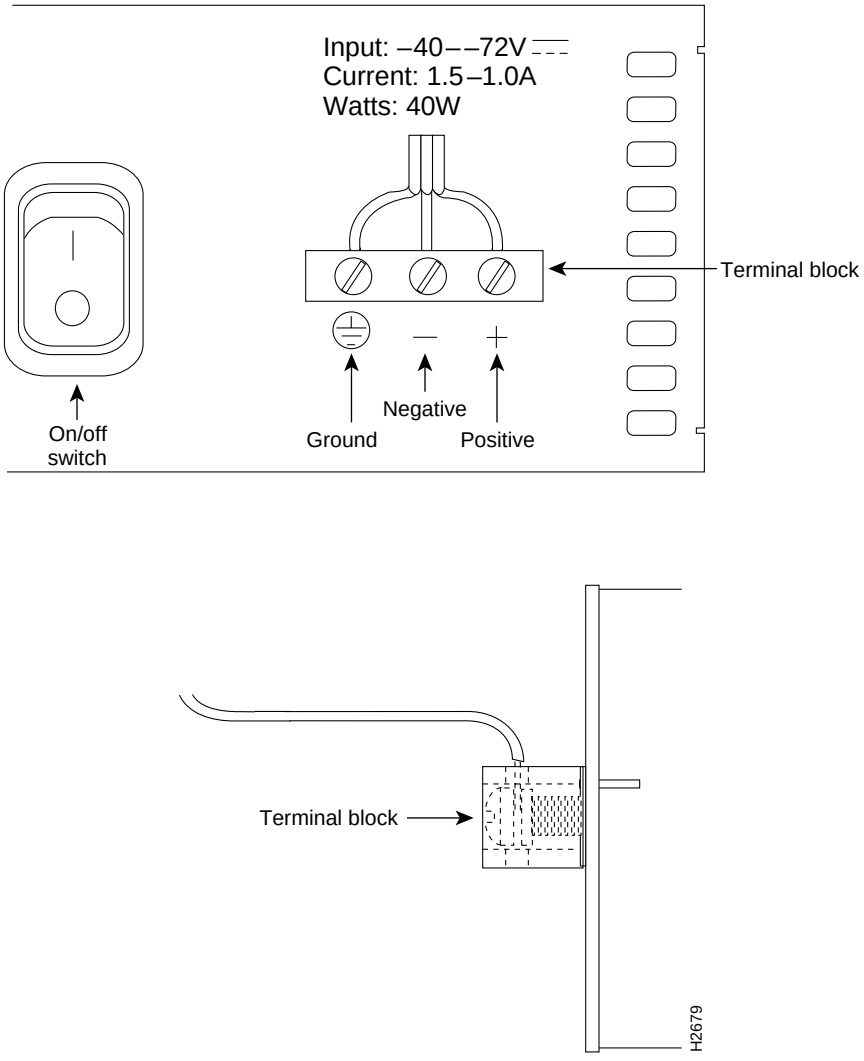
Warning The illustration shows the DC power supply terminal block. Wire the DC power supply using the appropriate lugs at the wiring end, as illustrated. The proper wiring sequence is ground to ground, positive to positive (line to L), and negative to negative (neutral to N). Note that the ground wire should always be connected first and disconnected last. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Warning When stranded wiring is required, use approved wiring terminations, such as closed-loop or spade-type with upturned lugs. These terminations should be the appropriate size for the wires and should clamp both the insulation and conductor. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Caution Do not overtorque the terminal block captive thumbscrew or terminal block contact screws. The recommended torque is 8.2 ± 0.4 inch-lb.

Warning After wiring the DC power supply, remove the tape from the circuit breaker switch handle and reinstate power by moving the handle of the circuit breaker to the on position. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Figure 3-10 DC Power Supply Connections



For additional information on power supplies refer to the section “Troubleshooting the Power and Cooling Systems” in the appendix “Troubleshooting the Router.”

Connecting to a Network

This section explains how to connect the router to your LAN and a WAN.

The cables required to connect the router to a network are not provided. To order a cable, see the section “Obtaining Service and Support” in the “Overview of the Router” chapter. Or see the appendix “Cable Specifications” for cable and port pinouts.

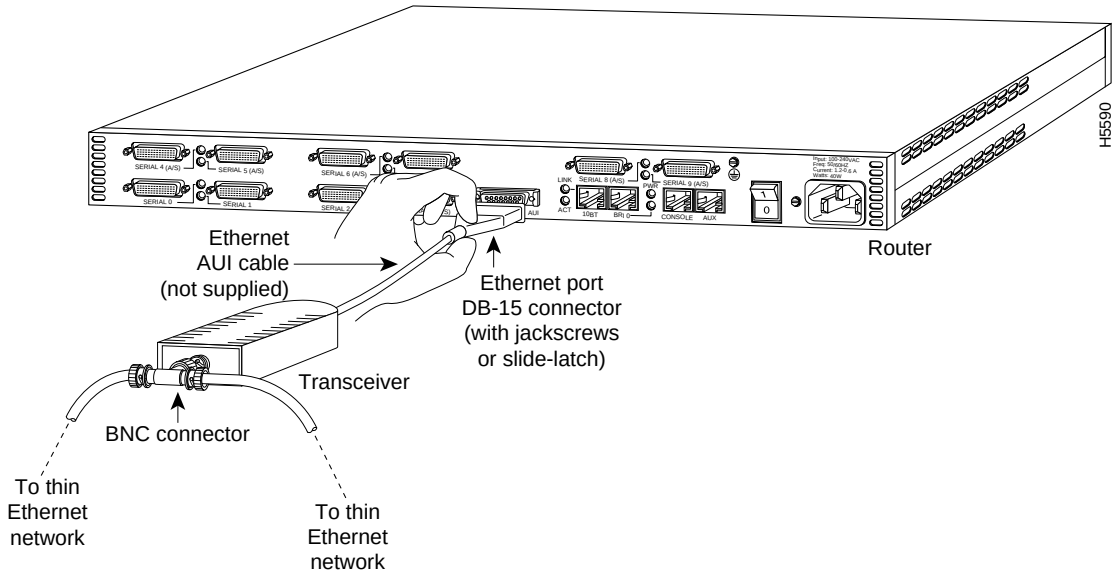
Warning Do not work on the system or connect or disconnect cables during periods of lightning activity. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Take the following steps to connect the router to your networks:

Note For Ethernet equipped routers, start with Step 1, for Token Ring equipped routers start with Step 2.

Step 1 Connect the Ethernet AUI port (DB-15) to a transceiver using an Ethernet transition cable and transceiver, as shown in Figure 3-11. Or connect a transceiver directly to the Ethernet AUI port.

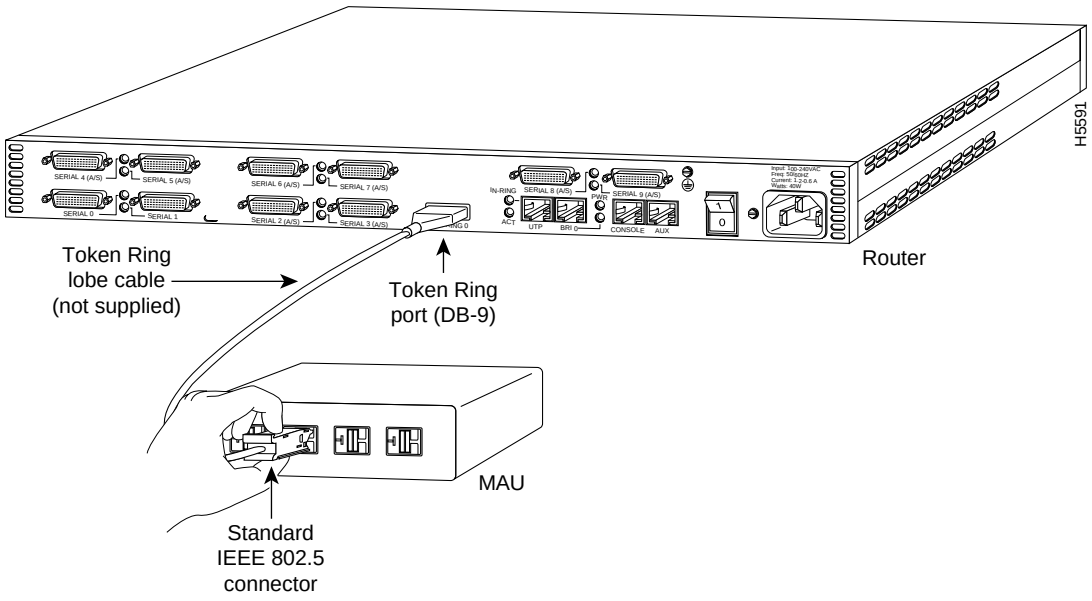
Figure 3-11 Connecting Ethernet Transition Cables



Step 2 Connect the Token Ring port (DB-9) to a MAU. (See Figure 3-12.) To ensure agency compliance with electromagnetic interference (EMI), make sure the cable is shielded.

You can also connect the Token Ring port (RJ-45) to a Token Ring hub. If the transmission rate of your Token Ring network is 4 Mbps, use a UTP cable to connect the Token Ring port (RJ-45) to a Token Ring hub. If the transmission rate of your Token Ring network is 16 Mbps, use a STP cable to connect the Token Ring port (RJ-45) to a Token Ring hub.

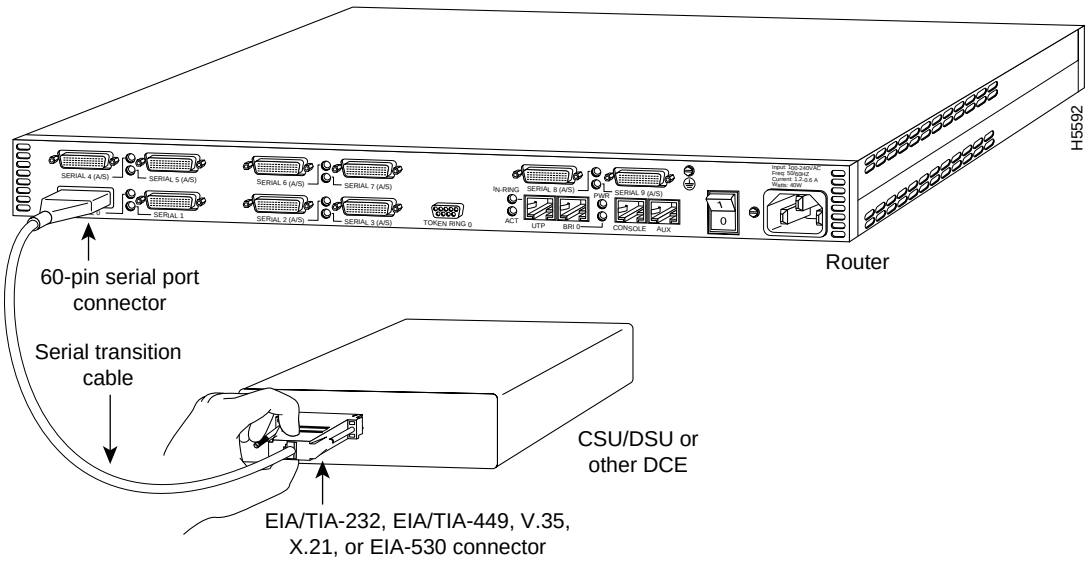
Figure 3-12 Connecting the Token Ring Cable



Step 3 If you will be using AutoInstall to configure the router, connect the synchronous serial port (DB-60) to a CSU/DSU or other DCE device, as shown in Figure 3-13. If you do not plan to use AutoInstall (or you are not sure what AutoInstall is) do not connect the WAN cable until after you have configured the router. If a WAN cable is connected when you power ON the router for the first time, it will attempt to run AutoInstall to download a configuration file from a TFTP server. It can take several minutes for the router to determine that the necessary files are not in place for AutoInstall to begin. For more information about AutoInstall, refer to the chapter "Configuring the Router."

Note The synchronous serial port supports the following signaling standards: EIA/TIA-232, EIA/TIA-449, V.35, X.21, and EIA-530.

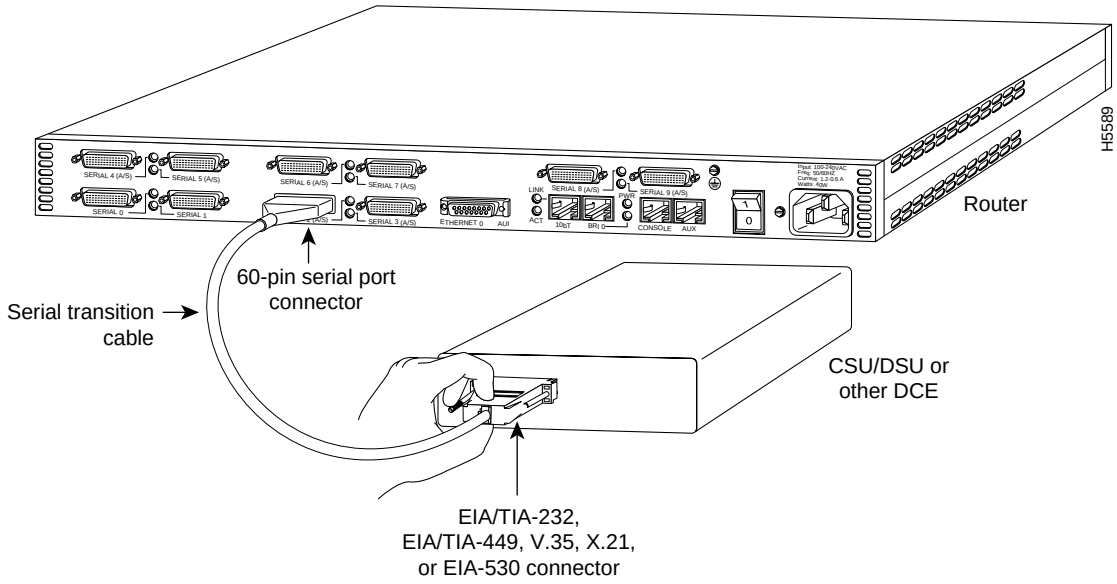
Figure 3-13 Connecting Synchronous Serial Cables



Step 4 Connect one end of each asynchronous/synchronous cable to the asynchronous/synchronous ports (labeled SERIAL *n* (A/S)), and then connect the other end to a CSU/DSU or asynchronous device. (See Figure 3-14.)

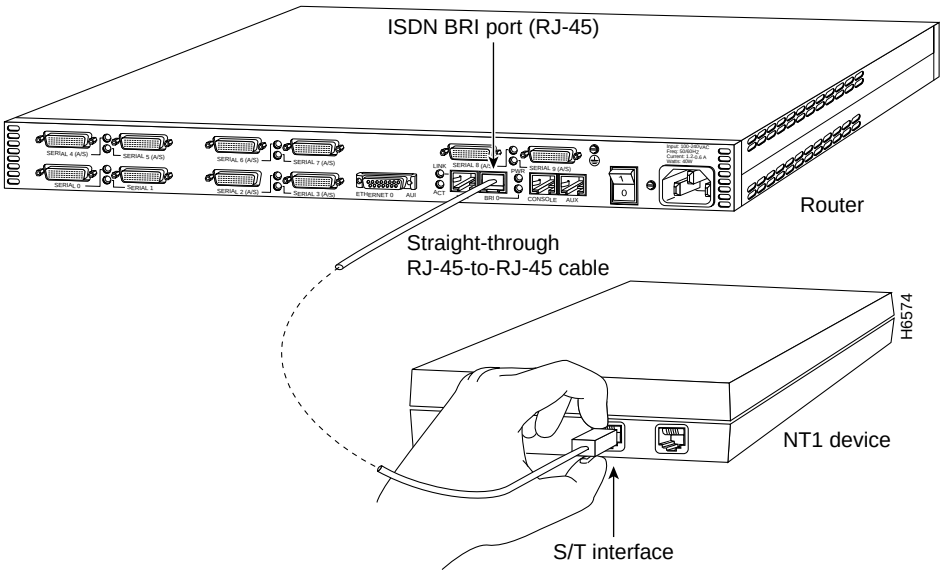
For asynchronous/synchronous port pinouts, refer to the appendix "Cable Specifications."

Figure 3-14 Connecting Asynchronous Serial Cables



Step 5 Connect the ISDN BRI port (RJ-45) to an NT1 device. (See Figure 3-15)

Figure 3-15 Connecting the ISDN BRI Port to an NT1 Device



Connecting the Console Terminal and Modem

Your router includes an asynchronous serial console and an auxiliary port. The console and auxiliary ports provide access to the router either locally (with a console terminal) or remotely (with a modem).

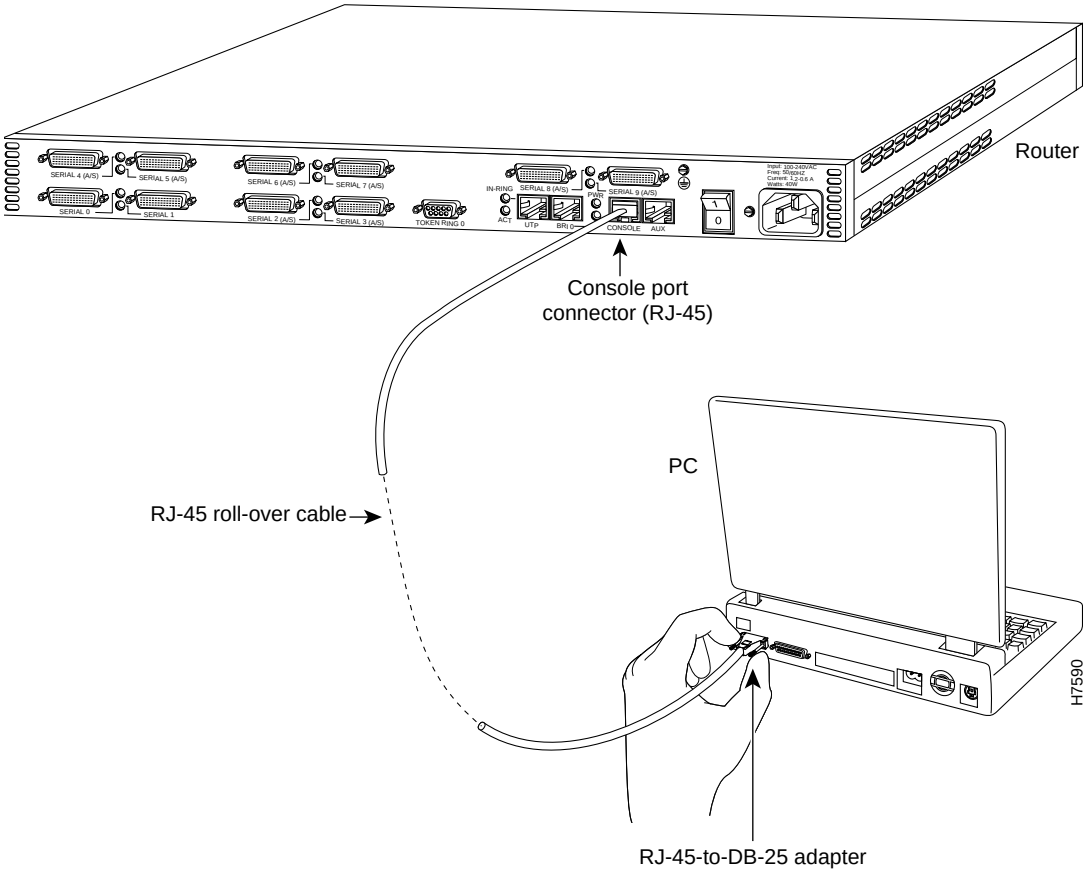
Connecting to the Console Port

Take the following steps to connect a terminal (an ASCII terminal or a PC running terminal emulation software) to the console port on the router:

Step 1 Connect the terminal using the thin, flat, RJ-45-to-RJ-45 roll-over cable (looks like a telephone cable) and an RJ-45-to-DB-9 or RJ-45-to-DB-25 adapter (labeled “TERMINAL”) included with the router. (See Figure 3-16.)

Step 2 Configure your terminal or PC terminal emulation software for 9600 baud, 8 data bits, no parity, and 2 stop bits.

Figure 3-16 Connecting the Console Terminal to the Console Port



Connecting a Modem to the Auxiliary Port

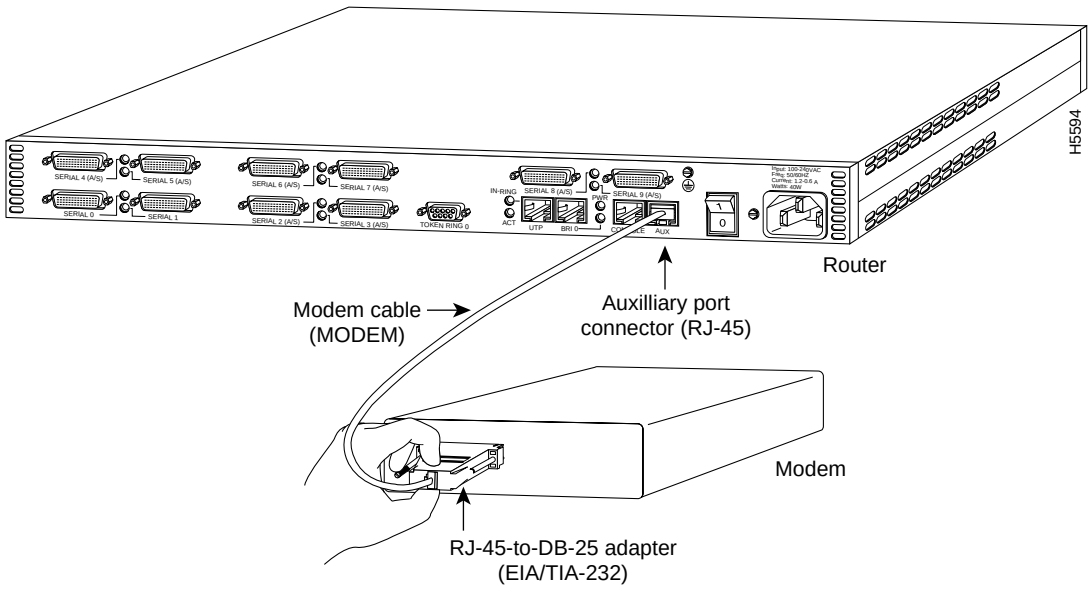
Take the following steps to connect a modem to the auxiliary port on the router:

Step 1 Connect a modem to the auxiliary port using the thin, flat, RJ-45-to-RJ-45 roll-over cable (looks like a telephone cable) with the RJ-45-to-DB-25 adapter (labeled "MODEM") included with the router. (See Figure 3-17.)

Step 2 Make sure that your modem and the auxiliary port on the router are configured for the same transmission speed (38400 baud is typical) and hardware flow control with Data Carrier Detect (DCD) and Data Terminal Ready (DTR) operations.

Warning This equipment is intended to be grounded. Ensure that the host is connected to earth ground during normal use. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Figure 3-17 Connecting a Modem to the Auxiliary Port



What to Do after Installing the Router Hardware

After you have installed the router, proceed to the chapter “Configuring the Router,” for software configuration information.

Note Refer to the Cisco configuration guide and command reference publications for additional software configuration information. These publications are available on the documentation CD that came with the router or you can order printed copies. Refer to the section “Ordering Documentation.”

CHAPTER 4

Configuring the Router

This chapter describes the procedures for configuring the model 2520, model 2521, model 2522, and model 2523 routers, and contains the following sections:

- Booting the Router for the First Time
- Configuring the Router
- Specifying the Boot Method
- Checking the Configuration Settings
- Getting More Information

This chapter provides minimum software configuration information; it is not meant to provide comprehensive router configuration instructions. Detailed software configuration information is available in the Cisco IOS configuration guide and command reference publications (available on the documentation CD that came with your router or you can order printed copies.)

To configure the multiport serial routers, a terminal must be connected to the console port.

Booting the Router for the First Time

Each time you power on the router, it goes through the following boot sequence:

1. The router goes through power-on self-test diagnostics to verify basic operation of the CPU, memory, and interfaces.
2. The system bootstrap software (boot ROM image) executes and searches for a valid Cisco IOS image (router operating system software). The source of the Cisco IOS image (Flash memory or a Trivial File Transfer Protocol [TFTP] server) is determined

by the configuration register setting. The factory-default setting for the configuration register is 0x2102, which indicates that the router should attempt to load a Cisco IOS image from Flash memory.

3. If after five attempts a valid Cisco IOS image is not found in Flash memory, the router reverts to boot ROM mode (which is used to install or upgrade a Cisco IOS image).
4. If a valid Cisco IOS image is found, then the router searches for a valid configuration file.
5. If a valid configuration file is not found in NVRAM, the router runs the System Configuration Dialog so you can configure it manually. For normal router operation, there must be a valid Cisco IOS image in Flash memory and a configuration file in NVRAM.

The first time you boot your router, you will need to configure the router interfaces and then save the configuration to a file in NVRAM. Proceed to the next section, "Configuring the Router," for configuration instructions.

Configuring the Router

You can configure the router following one of the procedures:

- Using Configuration Mode—Recommended if you are familiar with Cisco IOS commands.
- Using AutoInstall—Recommended for automatic installation if another router running Cisco IOS is installed on the network. This configuration method must be set up by an advanced Cisco IOS user.
- Using the Setup Facility—Recommended if you are not familiar with Cisco IOS commands.

Proceed with the procedure that best fits the needs of your network configuration and Cisco IOS experience level.

Note You need to obtain the correct network addresses from your system administrator or consult your network plan to determine correct addresses before you can complete the configuration of your multiport serial router.

Using Configuration Mode

You can configure the router manually if you prefer not to use the setup facility or AutoInstall.

Take the following steps to manually configure the router in configuration mode:

Step 1 Connect a terminal by following the instructions described in the section "Connecting the Console Terminal and Modem" in the chapter "Installing the Router" and then power up the router.

Step 2 When asked if you would like to enter the initial dialog, answer **no** to go into the normal operating mode of the router:

```
Would you like to enter the initial dialog? [yes]: no
```

Step 3 After a few seconds you will see the user EXEC prompt (Router>). Type **enable** to enter the enable mode. Configuration changes can only be made in enable mode:

```
Router> enable
```

The prompt changes to the privileged EXEC mode prompt:

```
Router#
```

Step 4 Enter the **config terminal** command at the enable prompt to enter configuration mode:

```
Router# config terminal
```

You can now make any changes you want to the configuration. Press **Ctrl-Z** to exit configuration mode.

To see the currently operating configuration, enter the **show running-config** command at the enable prompt:

```
Router# show running-config
```

To see the configuration in NVRAM, enter the **show startup-config** command at the enable prompt.

```
Router# show startup-config
```

To make your changes permanent, enter the **copy running-config startup-config** command at the enable prompt:

```
Router# copy running-config startup-config
```

The results of the **show running-config** and **show startup-config** commands differ if you have made changes to the configuration but have not yet written them to NVRAM.

The router is now configured and will boot with the configuration you have entered.

Using AutoInstall

The AutoInstall process is designed to configure the multiport serial router automatically after connection to the WAN. In order for AutoInstall to work properly, a Transmission Control Protocol/Internet Protocol (TCP/IP) host on the network must be preconfigured to provide the required configuration files. The TCP/IP host can exist anywhere on the network providing the following two conditions are maintained:

1. The host must be on the remote side of the multiport serial router's synchronous serial connection to the WAN.
2. User Datagram Protocol (UDP) broadcasts to and from the multiport serial router and the TCP/IP host must be enabled.

Refer to the configuration guide for additional information.

Note AutoInstall only works on synchronous serial connections.

Take the following steps to prepare your multiport serial router for the AutoInstall process:

Step 1 Attach the synchronous serial cable to the router.

Step 2 Turn ON power to the router.

The router loads the operating system image from Flash memory. If the remote end of the WAN connection is connected and properly configured, the AutoInstall process begins.

If the AutoInstall process is successfully completed, continue to Step 3 to write the configuration data to the multiport serial router's nonvolatile random-access memory (NVRAM). If the Autoinstall process is not successfully completed, contact your system administrator for assistance.

Step 3 At the enable prompt, enter the **copy running-config startup-config** command:

```
Router# copy running-config startup-config
```

This command saves the configuration settings that the AutoInstall process created in the router. If you fail to do this, the configuration is lost the next time you reload the router.

Using the Setup Facility

If you do not plan to use AutoInstall, do not connect the multiport serial router's WAN and (serial) cable to the channel service unit/data service unit (CSU/DSU). This prevents the router from attempting to run the AutoInstall process. The router attempts to run AutoInstall whenever you start it if the WAN connection is connected on both ends and the router does not have a configuration stored in NVRAM. It can take several minutes for the router to determine that AutoInstall is not set up to a remote TCP/IP host.

Once the router has determined that AutoInstall is not configured, it defaults to the setup facility. If the WAN cable is not connected, the router boots from Flash memory and goes into the setup facility.

Note You can run the setup facility any time from the enable prompt (#) by entering the **setup** command.

Configuring the Global Parameters

You use the setup facility to configure the global parameters, which are used for controlling system-wide settings. Take the following steps to enter the global parameters:

Step 1 Connect a terminal by following the instructions in the section "Connecting the Console Terminal and Modem" in the chapter "Installing the Router" and then boot the router to the user EXEC prompt (Router>).

Step 2 After booting from Flash memory, the following information appears after about 30 seconds.

Note The messages displayed vary, depending on the Cisco IOS release and feature set you selected. The screen displays in this section are for reference only and may not exactly reflect the screen displays on your console.

When the following information is displayed, you have successfully booted the router:

```
System Bootstrap, Version X.X(Xa), SOFTWARE
Copyright (c) 19XX-19XX by Cisco Systems
2500 processor with 16384 Kbytes of main memory

Loading igs-c-l.110-0.7 at 0x3000040, size = 3865444 bytes [OK]

F3: 3779532+85880+173868 at 0x3000060
              Restricted Rights Legend

Use, duplication, or disclosure by the Government is
subject to restrictions as set forth in subparagraph
(c) of the Commercial Computer Software - Restricted
Rights clause at FAR sec. 52.227-19 and subparagraph
(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.

           Cisco Systems, Inc.
           170 West Tasman Drive
           San Jose, California 95134-1706


Cisco Internetwork Operating System Software
IOS (tm) 3000 Software (IGS-C-L), Version 11.0(5), SOFTWARE
Copyright (c) 19XX-19XX by cisco Systems, Inc.
Compiled Mon 19-Jun-XX 23:22 by
Image text-base: 0x030200E4, data-base: 0x00001000

Cisco 2500 (68030) processor (revision C) with 16380K/2048K bytes of
memory.
Processor board ID 2685538369
```

```
SuperLAT software copyright 1990 by Meridian Technology Corp).
TN3270 Emulation software (copyright 1994 by TGV Inc).
X.25 software, Version 2.0, NET2, BFE and GOSIP compliant.
Bridging software.
Authorized for Enterprise software set.  (0x0)
1 Ethernet/IEEE 802.3 interface.
2 Serial network interfaces.
8 low-speed (sync/async) network interfaces.
32K bytes of non-volatile configuration memory.
4096K bytes of processor board System flash (Read ONLY)

Notice: NVRAM invalid, possibly due to write erase.

         --- System Configuration Dialog ---


At any point you may enter a question mark '?' for help.
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.
```

Step 3 Enter **yes** or press **Return** (the default) when you are asked if you would like to enter the configuration dialog and if you would like to see the current interface summary:

```
Would you like to enter the initial configuration dialog? [yes]:

First, would you like to see the current interface summary? [yes]:

Any interface listed with OK? value "NO" does not have a valid
configuration

Interface    IP-Address      OK?  Method     Status  Protocol
Ethernet0    unassigned      NO   not set    up      down
Serial0      unassigned      NO   not set    down    down
Serial1      unassigned      NO   not set    down    down
Serial2      unassigned      NO   not set    down    down
Serial3      unassigned      NO   not set    down    down
```

Step 4 Choose the supported protocols on the Ethernet or Token Ring interface. For IP-only installations, accept the default values for most of the questions.

A typical configuration using IP, IPX, and AppleTalk follows:

```
Configuring global parameters:

Enter host name [Router]: router
```

Step 5 Enter the enable secret password, the enable password, and the virtual terminal password:

```
The enable secret is a one-way cryptographic secret used
instead of the enable password when it exists.

Enter enable secret : shovel

The enable password is used when there is no enable secret
and when using older software and some boot images.

Enter enable password : trowel
Enter virtual terminal password: pail
```

Enter **yes** or **no** to accept or refuse SNMP management:

```
Configure SNMP Network Management? [yes]:no
```

The Simple Network Management Protocol (SNMP) is the most widely supported open standard for network management. It provides a means to access and set the configuration and run-time parameters of a multiport serial router. SNMP defines a set of functions used to monitor and control network elements.

Step 6 Determine if you are using DECnet on the router. If you are configuring for DECnet, enter the appropriate values for your area number, node number, and area routing:

```
Configure DECnet? [no]:
```

Step 7 In most cases, you use IP routing. For IP routing, you must also select one of two interior routing protocols: Interior Gateway Routing Protocol (IGRP) or Routing Information Protocol (RIP).

Enter **yes** or press **Return** (the default) to configure IP, and then select an interior routing protocol for IP:

```
Configure IP? [yes]:
  Configure IGRP routing? [yes]:
    Your IGRP autonomous system number [1]: 15
Configure CLNS? [no]:
Configure bridging? [no]:
Configure IPX? [no]: yes
Configure XNS? [no]:
Configure Apollo? [no]:
```

Step 8 Enter the ISDN BRI switch type for the router. The ISDN switch type appropriate for the router depends on the ISDN provider's equipment. Table 4-1 lists the ISDN switch types.

```
Enter ISDN BRI Switch Type [none]: basic-5ess
```

Table 4-1 ISDN Switch Types

Country:	ISDN Switch Type	Description
Australia	basic-ts013	Australian TS013 switches
Europe	basic-1tr6	German 1TR6 ISDN switches
	basic-nwnet3	Norwegian NET3 ISDN switches (phase 1)
	basic-net3	NET3 ISDN switches (UK and others)
	basic-net5	NET5 switches (UK and Europe)
	vn2	French VN2 ISDN switches
	vn3	French VN3 ISDN switches
	basic-1tr6	German 1TR6 ISDN switches
	basic-nwnet3	Norwegian NET3 ISDN switches (phase 1)
Japan	ntt	Japanese NTT ISDN switches
New Zealand	basic-nznet3	New Zealand NET3 switches

Table 4-1 ISDN Switch Types (Continued)

Country:	ISDN Switch Type	Description
North America	basic-5ess	AT&T basic rate switches
	basic-dms100	NT DMS-100 basic rate switches
	basic-ni1	National ISDN-1 switches

Configuring the ISDN BRI Interface

This section explains how to configure the ISDN BRI interface. If an ISDN BRI WAN module is not installed in your router, skip this section and proceed with the next section, "Configuring the Ethernet or Token Ring Interfaces."

The ISDN BRI interface is configured to allow connection to ISDN WANs. Take the following steps to configure the ISDN BRI interface:

Step 1 Press **Return** or enter **yes** to configure the ISDN BRI port:

```
Configuring interface BRI0:
Is this interface in use? [yes]
Configure IP on this interface? [yes]
IP address for this interface: 172.16.71.1
Number of bits in subnet field [0]: 8
lass B network is 172.16.0.0, 8 subnet bits; mask is
    255.255.255.0
  Configure AppleTalk on this interface? [no]: yes
    Extended AppleTalk network? [no]: yes
    AppleTalk starting cable range [0]: 1
    AppleTalk ending cable range [1]: 2
    AppleTalk zone name [myzone]:
    AppleTalk additional zone name: otherzone
    AppleTalk additional zone name:
  Configure IPX on this interface? [no]: yes
    IPX network number [1]: B000
```

In this example, routing is enabled on AppleTalk and IPX; IP has already been selected:

```
Configure AppleTalk? [no]: yes
  Multizone networks? [no]: yes

Configure LAT? [yes]: no
Configure IPX? [no]: yes
```

Configuring the Ethernet or Token Ring Interfaces

Take the following steps to configure the Ethernet or Token Ring interface to allow communication over a LAN. To configure the interface parameters, you need to know the Ethernet or Token Ring interface network addresses. In the following example, the system is being configured for an Ethernet LAN using IP.

Step 1 Respond as follows (using your own address and subnet bits) to the setup prompts:

```
Configuring interface Ethernet0:
  Is this interface in use? [yes]:
 Configure IP on this interface? [yes]:
    IP address for this interface: 172.16.72.1
    Number of bits in subnet field [0]: 8

   Class B network is 172.16.0.0, 8 subnet bits; mask is 255.255.255.0
```

Step 2 Enter **yes** if you are using AppleTalk on the interface, enter **yes** to configure for extended AppleTalk networks, and then enter the cable range number. Enter the zone name, and any other additional zones that are associated with the local zone:

```
Configure AppleTalk on this interface? [no]: yes
    Extended AppleTalk network? [no]: yes
    AppleTalk starting cable range [0]: 1
    AppleTalk ending cable range [1]: 2

    AppleTalk zone name [myzone]:
    AppleTalk additional zone name: otherzone
    AppleTalk additional zone name:
```

Step 3 If IPX is enabled on this interface, enter the unique IPX network number:

```
Configure IPX on this interface? [no]: yes
    IPX network number [1]: B001
Configure XNS on this interface? [no]
```

Configuring the Synchronous Serial Interfaces

The synchronous serial interfaces are configured to allow connection to WANs through a CSU/DSU. All serial ports on the multiport serial router are initially configured as synchronous ports. When the initial configuration is completed, configure the serial ports you plan to use as asynchronous ports using the **physical-layer** command in configuration mode. Take the following steps to configure the serial port(s):

Step 1 Enter **yes** to configure serial port 0:

```
Configuring interface Serial0:
  Is this interface in use? [no]: yes
```

Step 2 Determine what protocols you want on the synchronous serial interface and enter the appropriate responses:

```
Configure IP unnumbered on this interface? [no]: no
    IP address for this interface: 172.16.73.1
    Number of bits in subnet field [8]:
Class B network is 172.16.0.0, 8 subnet bits; mask is 255.255.255.0

Configure AppleTalk on this interface? [no]: yes
    Extended AppleTalk network? [yes]:

    AppleTalk starting cable range [2]: 3
    AppleTalk ending cable range [3]: yes

    AppleTalk zone name [myzone]: ZZ Serial
    AppleTalk additional zone name:

Configure IPX on this interface? [no]: yes
    IPX network number [2]: B000
```

Step 3 Configure the second synchronous serial interface:

```
Configuring interface Serial1:
  Is this interface in use? [no]: yes

Configure IP unnumbered on this interface? [no]: yes
    IP address for this interface: 172.16.74.2
    Number of bits in subnet field [8]:
Class B network is 172.16.0.0, 8 subnet bits; mask is 255.255.255.0

 Configure AppleTalk on this interface? [no]: yes
    Extended AppleTalk network? [yes]:
    AppleTalk starting cable range [2]: 4
    AppleTalk ending cable range [3]: 4

    AppleTalk zone name [myzone]: ZZ Serial
    AppleTalk additional zone name:

 Configure IPX on this interface? [no]: yes
    IPX network number [2]: B002
```

Step 4 Continue to configure the remaining serial port(s) using similar parameters.

The multiport serial router is now configured properly and is ready to use. Enter the **setup** command to modify the parameters after the initial configuration. Enter the **configure** command to perform more complex configurations. For additional information, refer to the publication Cisco IOS command reference publication.

Step 5 Check the router settings by entering the **show running-config** command at the enable prompt:

```
Router# show running-config
.
.
.
configuration register is 0x2102
```

Step 6 Store the configuration, or changes to the startup configuration, by entering the **copy running-config startup-config** command at the enable prompt:

```
Router# copy running-config startup-config
```

Entering this command saves the configuration settings that the setup process created in the router. If you fail to do this, the configuration is lost the next time the router is loaded.

Setting Asynchronous Serial Ports

The ports you plan to use as low-speed asynchronous serial ports must be reconfigured after the initial setup because the ports are initially configured as low-speed synchronous serial ports.

Take the following steps to configure a synchronous serial port to be an asynchronous serial port:

Step 1 Connect a terminal by following the instructions in the section "Connecting the Console Terminal and Modem" in the chapter "Installing the Router" and then power up the router.

Step 2 Enter the **config terminal** command at the enable prompt to enter configuration mode:

```
router# config terminal
```

You can now make changes to the configuration. Press **Ctrl-Z** to exit configuration mode.

Step 3 Enter the **interface** command to select the port you are configuring:

```
interface serial 2
```

Step 4 Enter the **physical-layer** command to change the port to asynchronous:

```
physical-layer async
```

Step 5 Enter the IP address, the asynchronous mode, and routing method:

```
ip address 172.16.2.2 255.0.0.0
async mode dedicated
async default routing
```

Setting Synchronous Serial Ports

Take the following steps to configure a low-speed asynchronous serial port to be a low-speed synchronous serial port:

Step 1 Connect a terminal by following the instructions in the section "Connecting the Console Terminal and Modem" in the chapter "Installing the Router" and then power up the router.

Step 2 Enter the **config terminal** command at the enable prompt to enter configuration mode:

```
Router# config terminal
```

You can now make changes to the configuration. Press **Ctrl-Z** to exit configuration mode.

Step 3 Enter the **interface** command to select the port you are configuring:

```
interface serial 2
```

Step 4 Enter the **physical-layer** command to set the port to synchronous:

```
physical-layer sync
```

Setting Half-Duplex Mode

Low-speed serial ports that are set as DCE can be set to use either controlled carrier mode or constant carrier mode.

Controlled carrier mode sets the interface to deactivate DCD until a transmission is sent to the interface. DCD is then activated, and the interface waits an amount of time you configure, and then transmits the data. After the transmission, the interface waits for a period of time and then deactivates DCD.

Constant carrier mode (the default for low-speed interfaces) activates DCD at all times.

Take the following steps to enable controlled carrier mode:

Step 1 Connect a terminal by following the instructions in the section "Connecting the Console Terminal and Modem" in the chapter "Installing the Router" and then power up the router.

Step 2 Enter the **config terminal** command at the enable prompt to enter configuration mode:

```
Router# config terminal
```

You can now make changes to the configuration. Press **Ctrl-Z** to exit configuration mode.

Step 3 Enter the **half-duplex** command to reset the port from constant carrier mode to controlled carrier mode:

```
interface serial 2
half-duplex controlled carrier
```

Step 4 Enter the **no half-duplex** command to return to constant carrier mode:

```
interface serial 2
no half-duplex controlled carrier
```

Step 5 Enter the **half-duplex timer** command to specify the time that the interface delays when in controlled carrier mode. For example, to configure the DCD drop delay, enter the following commands, using appropriate values for your system:

```
interface serial 2
half-duplex timer dcd-drop-delay 100 ms
```

The amount of time is specified in milliseconds.

Step 6 Enter the **timer** command to tailor the delay times for the router ports. Table 4-2 lists the **timer** commands and their default settings.

Table 4-2 Half-Duplex Timer Commands

Timer	Syntax	Default Setting (Milliseconds)
CTS delay	**half-duplex timer cts-delay**	100
CTS drop timeout	**half-duplex timer cts-drop-timeout**	5000
DCD drop delay	**half-duplex timer dcd-drop-delay**	100
DCD transmission start delay	**half-duplex timer dcd-txstart-delay**	100
RTS drop delay	**half-duplex timer rts-drop-delay**	100

Table 4-2 Half-Duplex Timer Commands (Continued)

Timer	Syntax	Default Setting (Milliseconds)
RTS timeout	**half-duplex timer rts-timeout**	2000
Transmit delay	**half-duplex transmit-delay**	0

Specifying the Boot Method

You can enter multiple boot commands in the configuration in NVRAM to provide backup methods for loading the Cisco IOS image onto the router. The router boots using the first boot command that succeeds. If you enter multiple boot commands, the router executes them in the order they are entered. There are two ways to load the Cisco IOS image: from Flash memory or from a TFTP server on the network.

1. Flash memory

   Information stored in Flash memory is not vulnerable to network failures that might occur when you load system software from servers. In the following example, replace *filename* with the filename of the Cisco IOS image:

```
Router> enable
Password: enablepassword
Router# configure terminal
Router (config)# boot system flash filename
Router (config)# Ctrl-Z
Router# copy running-config startup-config
Building configuration ...
[OK]
Router# exit
Router>
```

2. TFTP server

   If Flash memory is not available, or if Flash memory does not contain a valid Cisco IOS image, you can specify that system software be loaded from a TFTP server on your Ethernet network as a backup boot method for the router. In the following example, replace *filename* with the filename of the Cisco IOS image, and replace *ipaddress* with the IP address of the TFTP server:

```
Router> enable
```

```
Password: enablepassword
Router# configure terminal
Router (config)# boot system tftp filename ipaddress
Router (config)# Ctrl-Z
Router# copy running-config startup-config
Building configuration ...
[OK]
Router# exit
Router>
```

For more information about the **configure terminal** command, refer to the command reference publication.

Checking the Configuration Settings

Enter the **show version** command to check the software version (third line from the top in the following display) and configuration register setting (at the end of the following display):

```
Router> show version
Cisco Internetwork Operating System Software
IOS (tm) XX00 Software (XXX-X-X), RELEASE SOFTWARE XX.X(XXXX) [XXX]
Copyright (c) 1986-199X by cisco Systems, Inc.
Compiled Tue XX-XXX-XX 13:07 by XXXXX
Image text-base: 0x03032810, data-base: 0x00001000

ROM: System Bootstrap, Version X.X(XXXX) [XXXXX], RELEASE SOFTWARE
ROM: XX00 Bootstrap Software (XXX-BOOT-X), Version XX.X(XXXXX) [XXXXX]

Router uptime is 4 minutes
System restarted by power-on
System image file is "flash:XXX/XXX-X-X.Nov14", booted via flash

cisco XXXX(68030) processor (revision X) with 4092K/2048K bytes of memory.
Processor board ID 00000000
Bridging software.
SuperLAT software copyright 199X by Meridian Technology Corp).
X.25 software, Version X.X, NET2, BFE and GOSIP compliant.
TN3270 Emulation software (copyright 199X by TGV Inc).
1 Ethernet/IEEE 802.3 interface.
2 Serial network interfaces.
No module installed for Serial Interface 0
No module installed for Serial Interface 1
```

```
32K bytes of non-volatile configuration memory.
8192K bytes of processor board System flash (Read ONLY)

Configuration register is 0x2102

Router>
```

Getting More Information

For more information about router software configuration, refer to the Cisco IOS configuration guide and command reference publications. These publications are available on the documentation CD that accompanied your router. To order the documentation CD, or paper documentation, refer to the information packet publication that accompanied your router.

APPENDIX A

Troubleshooting the Router

This appendix contains information about how to isolate problems with the router and includes the following sections:

- Isolating Problems
- Reading the LEDs

Isolating Problems

The key to problem solving in this system is to try to isolate the problem to a specific subsystem. By comparing what the system is doing to what it should be doing, the task of isolating the problem is greatly simplified.

When problem solving, consider the following subsystems:

- Power and cooling systems—The power supply, power cable, and fan
- Ports and cables—The ports on the rear panel of the router and the cables that connect to them

Troubleshooting the Power and Cooling Systems

Check the following items to help isolate the problem:

- When the power switch is in the ON position (|) and the System OK LED is ON, are the fans operating? If not, check the fans.
- Does the router shutdown after being ON a short time? Check the environmental conditions. The router might be overheating, resulting in a thermal-induced shutdown. Ensure that the chassis intake and exhaust vents are clear. Review the section "General Site Requirements" in the chapter "Preparing to Install the Router." The operating temperature for the router is 32 to 104° F (0 to 40°C).
- Does the router fail to boot, but the System OK LED is ON? Check the power supply.
- Does the router constantly or intermittently reboot? There might be a problem with the processor, the software, or a DRAM SIMM might be installed incorrectly.

For information about obtaining technical support, refer to the "Overview of the Router" chapter.

Troubleshooting the Ports, Cables, and Connections

Check the following items to help isolate the problem:

- Does the router not recognize a port? Check the cable connection.
- When the power switch is in the ON position (|), does the System OK LED light up? If not, check the power source and power cable.
- Does the system boot, but the console screen is frozen? Verify that the console is configured for 9600 baud, 8 data bits, no parity, and 2 stop bits.

For additional troubleshooting information, refer to the *System Error Messages* and *Debug Command Reference* publications (available on the documentation CD that came with the router or you can order printed copies).

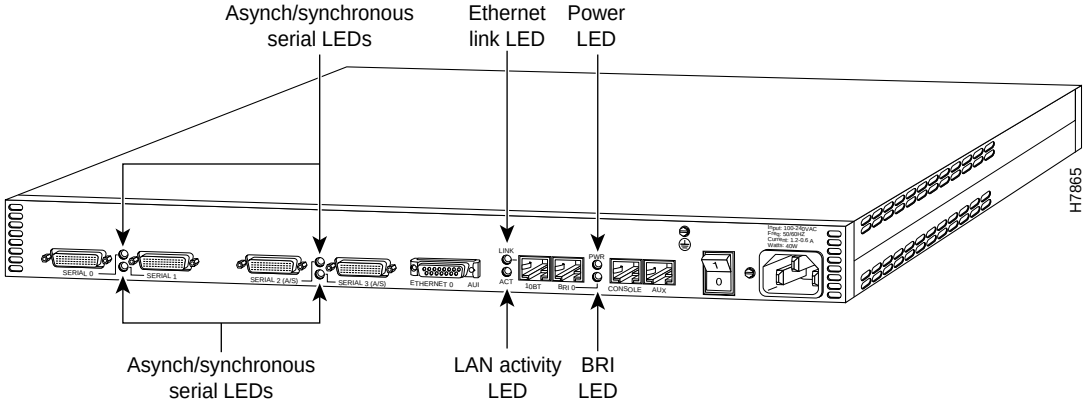
For information about obtaining technical support, refer to the section"Obtaining Service and Support" in the "Overview of the Router " chapter.

Reading the LEDs

The LEDs indicate the current operating condition of the router. You can observe the LEDs, note any fault condition that the router is encountering, and then contact your system administrator or technical support, if necessary. For information about how to contact technical assistance, refer to the section “Obtaining Service and Support” in the chapter “Overview of the router.”

Figure A-1 shows the location of the LEDs on the rear panel of the routers. The power LED, at the right of the auxiliary port, lights up when the system is working properly. All of the other LEDs indicate activity by flickering. When there is heavy activity on a port, the LED might be ON constantly. If an LED is not ON when the port is active and the cable is connected correctly, there might be a problem with the port.

Figure A-1 LED Locations



APPENDIX B

Maintaining the Router

This appendix contains selected maintenance procedures you might need to perform on the router as your internetworking needs change.

This appendix includes the following sections:

- Opening the Chassis
- Upgrading the DRAM SIMM
- Replacing the System-Code SIMMs
- Closing the Chassis

Additional maintenance procedures are available on the documentation CD that accompanied the router.

Caution Before opening the chassis, be sure that you have discharged all static electricity from your body and the power is OFF. Before performing any procedures described in this appendix, review the section "Safety Recommendations" in the chapter "Preparing to Install the Router."

Warning Before working on a chassis or working near power supplies, unplug the power cord on AC units; disconnect the power at the circuit breaker on DC units. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* publication.)

Opening the Chassis

This section describes the procedure for opening the chassis by removing the chassis cover.

Warning Do not touch the power supply when the power cord is connected. For systems with a power switch, line voltages are present within the power supply even when the power switch is OFF and the power cord is connected. For systems without a power switch, line voltages are present within the power supply when the power cord is connected. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* publication.)

Tools Required

You will need the following tools to open the chassis:

- Medium-size flat-blade screwdriver (1/4 inch [0.625 cm])
- Size M 3.5 (metric) hex-head nut driver (optional)

Removing the Chassis Cover

You must open the chassis to access its interior components. When opening the chassis, refer to Parts A and B in Figure B-1.

Warning Before opening the chassis, disconnect the telephone-network cables to avoid contact with telephone-network voltages. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* publication.)

Take the following steps to remove the chassis cover:

Step 1 Power OFF the router.

Step 2 Disconnect all cables from the rear panel of the router.

Step 3 Turn the unit upside down so that the top of the chassis is resting on a flat surface, and the front of the chassis is facing toward you. (See Figure B-1, Part A.)

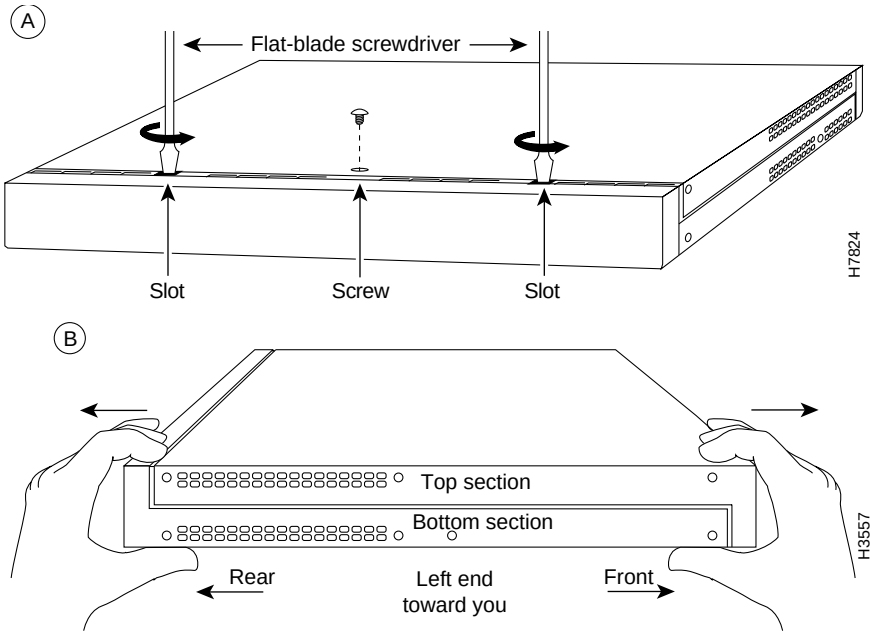
Step 4 Remove the single screw located on the bottom of the chassis (on the side closest to you). Note that the chassis is comprised of two sections: top and bottom.

Step 5 If required, insert a medium-size flat-blade screwdriver into the slots shown in Figure B-1, Part A, and gently rotate the blade so that the top and bottom sections separate slightly.

Step 6 Holding the chassis with both hands, position it as shown in Figure B-1, Part B.

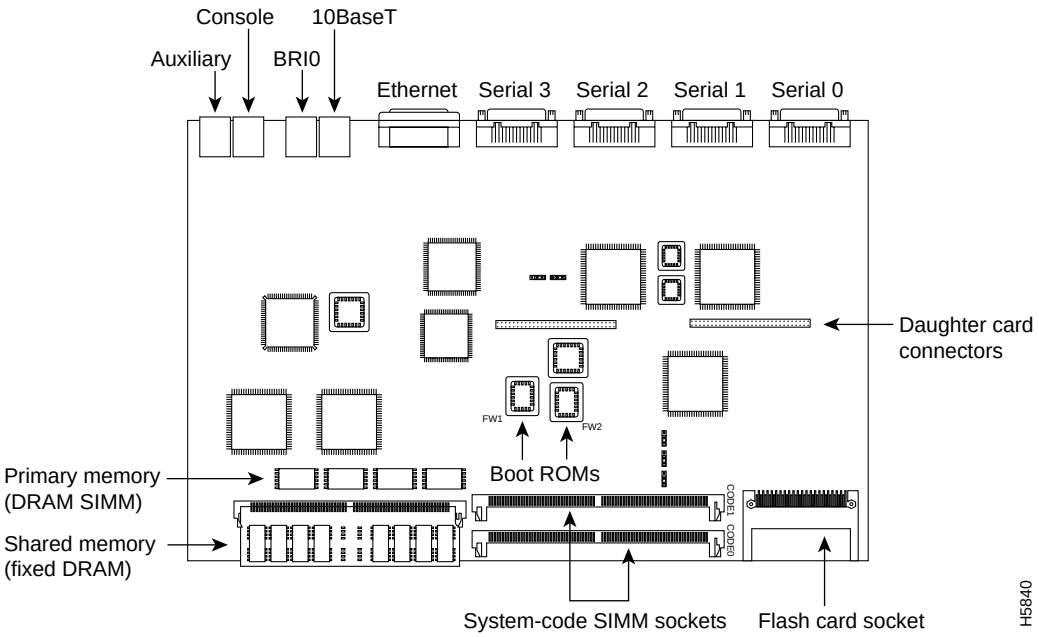
Step 7 Pull the top section away from the bottom section. (See Figure B-1, Part B.) The fit is very snug, so it may be necessary to pry the chassis sections apart at one end and then the other until they separate.

Figure B-1 Chassis Cover Removal



Step 8 When the top cover is off, set it aside. Figure B-2 shows the layout of the system card, which is the same for the routers.

Figure B-2 System Card Layout—Model 2520



Upgrading the DRAM SIMM

This section describes how to upgrade the DRAM SIMM on the system card. You might need to upgrade the DRAM SIMM for the following reasons:

- You upgrade the Cisco IOS feature set or release.
- Your router maintains large routing tables or other memory-intensive features, such as spoofing or protocol translations.

To see how much memory is currently installed in the router, enter the **show version** command. Near the middle of the resulting output, a message similar to the following displays:

```
Cisco XXXX(68030) processor (revision X) with 4092K/2048K bytes of memory.
```

This line shows how much memory is installed (in this example, 4092K/2048K). The first number represents primary memory and the second number represents shared memory.

Tools Required

You will need the following tools to remove and replace the DRAM SIMM on the router:

- Medium-size flat-blade screwdriver (1/4 inch [0.625 cm])
- ESD-preventive wrist strap
- The DRAM SIMM required for your planned upgrade

DRAM SIMM Installation

Take the following steps to install the DRAM SIMMs:

Step 1 Power OFF the router.

Step 2 Attach an ESD-preventive wrist strap.

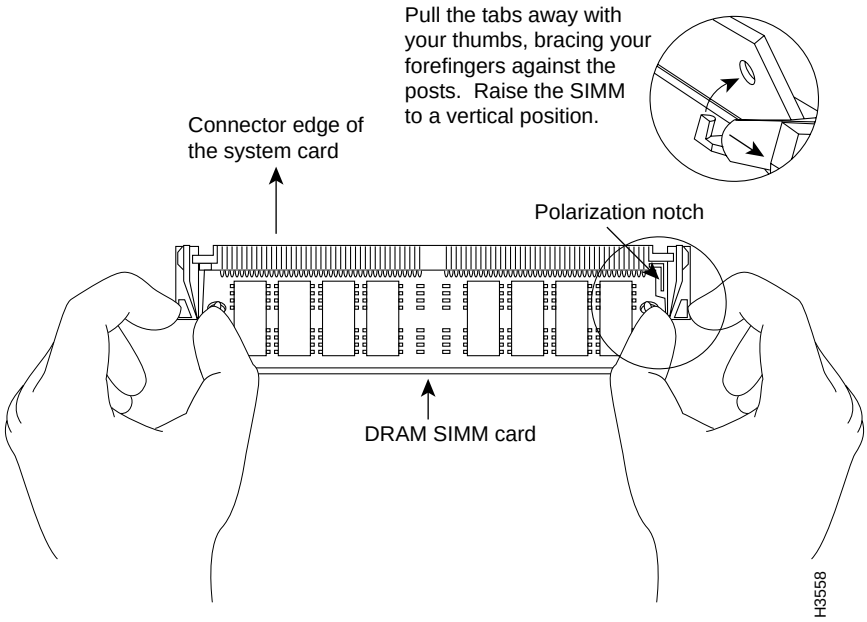
Step 3 Open the cover following the instructions in the section “Opening the Chassis” earlier in this appendix.

Step 4 Remove the existing DRAM SIMM by pulling outward on the connectors to unlatch them, as shown in Figure B-3. Be careful not to break the holders on the SIMM connector.

Caution To prevent damage, do not press on the center of the SIMMs. Handle each SIMM carefully.

Step 5 Position the new SIMM so that the polarization notch is located at the left end of the SIMM socket. (See Figure B-3.)

Figure B-3 Removing and Replacing the DRAM SIMM


Pull the tabs away with your thumbs, bracing your forefingers against the posts. Raise the SIMM to a vertical position.
Connector edge of the system card
Polarization notch
DRAM SIMM card
H3558

Step 6 Insert the new DRAM SIMM by sliding the end with the metal fingers into the SIMM connector socket at approximately a 45-degree angle to the system card. Gently rock the SIMM back into place until the latch on either side snaps into place. Do not use excessive force because the connector may break.

Step 7 Replace the router cover. Follow the instructions in the section "Closing the Chassis" later in this appendix.

Replacing the System-Code SIMMs

The system code (router operating system software) is stored in Flash memory SIMMs.

Tools Required

You will need the following tools to remove and replace the system-code SIMMs on the router:

- Medium-size flat-blade screwdriver (1/4 inch [0.625 cm])
- ESD-preventive wrist strap
- System-code SIMM(s)

Preparing to Install the System-Code SIMM

There are two system-code (Flash memory) SIMM sockets on the system board. If you want to install system-code SIMMs in both sockets, the SIMMs must be the same size. For example, if a 4-MB system-code SIMM is already installed in your router, the new SIMM must also be 4 MB. This upgrade would give you a total of 8 MB. You can verify how much Flash memory is already installed in your router by entering the **show flash** EXEC command.

Caution The system code is stored on the Flash memory SIMMs, but new system-code SIMMs are shipped without preinstalled software. Before proceeding with this procedure, use the **copy flash tftp** EXEC command to back up the system code to a TFTP server.

Note For more information about the **copy flash tftp** command and other related commands, refer to the Cisco IOS configuration and command reference publications.

System-Code SIMM Replacement

Take the following steps to upgrade the system-code Flash memory SIMMs:

Step 1 If you have not already done so, enter the **copy flash tftp** EXEC command to back up the system code.

Step 2 Power OFF the router.

Step 3 Remove all cables from the rear panel of the router.

Step 4 Attach an ESD-preventive wrist or ankle strap.

Step 5 Open the chassis cover following the procedure in the section "Opening the Chassis" earlier in this appendix.

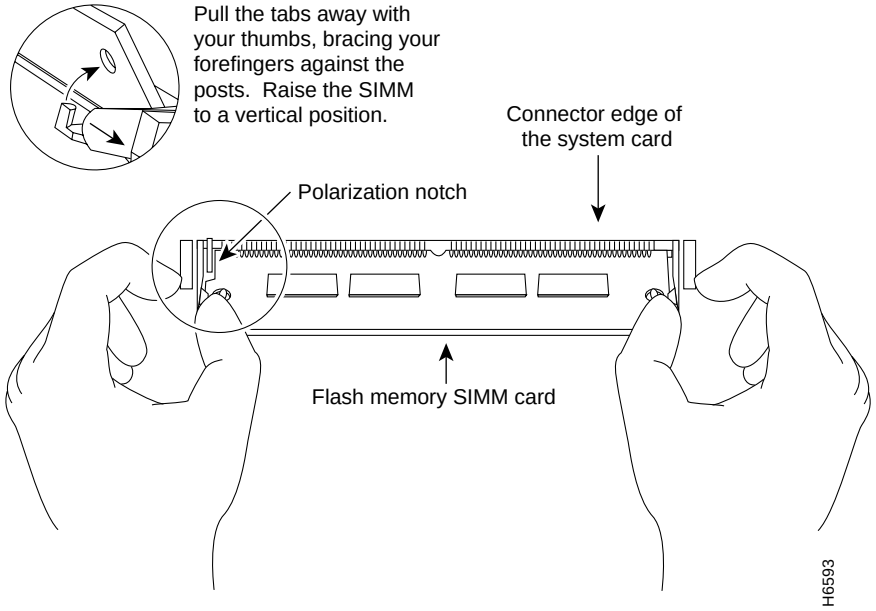
Step 6 Locate the system-code SIMMs on the system card, labeled CODE0 and CODE1. (See Figure B-2.)

Step 7 If necessary, remove the existing system-code SIMM by pulling outward on the connector holders to unlatch them. The connector holds the SIMM tightly, so be careful not to break the holders on the SIMM connector. (See Figure B-4.)

If you are installing system-code SIMMs in both sockets (CODE0 and CODE1), both SIMMs must be the same size. For example, if a 4-MB system-code SIMM is already installed in your router, the new SIMM must also be 4 MB. Populate the SIMM socket labeled CODE0 first; then populate CODE1.

Caution To prevent damage, do not press on the center of the SIMMs. Handle each SIMM carefully.

Figure B-4 Removing and Replacing the System-Code SIMM


Pull the tabs away with your thumbs, bracing your forefingers against the posts. Raise the SIMM to a vertical position.
Connector edge of the system card
Polarization notch
Flash memory SIMM card
H6593

Step 8 Position the new SIMM so that the polarization notch is located at the left end of the SIMM socket.

Caution To prevent damage, note that some Flash memory SIMMs have the components mounted on the rear side; therefore, when inserting the SIMM, always use the polarization notch as a reference and *not* the position of the components on the SIMM.

Step 9 Insert the new SIMM by sliding the end with the metal fingers into the appropriate SIMM connector socket (labeled CODE0 or CODE1) at approximately a 45-degree angle to the system card. Gently rock the SIMM back into place until the latches on both sides snap into place. Do not use excessive force because the connector may break.

Step 10 Replace the router cover following the procedure in the next section, "Closing the Chassis."

Closing the Chassis

This section describes the procedure for closing the chassis by replacing the cover.

Tools Required

You will need the following tools to replace the cover:

- Medium-size flat-blade screwdriver (1/4 inch [0.625 cm])
- Size M 3.5 hex-head nut driver (optional)

Replacing the Cover

Take the following steps to replace the cover:

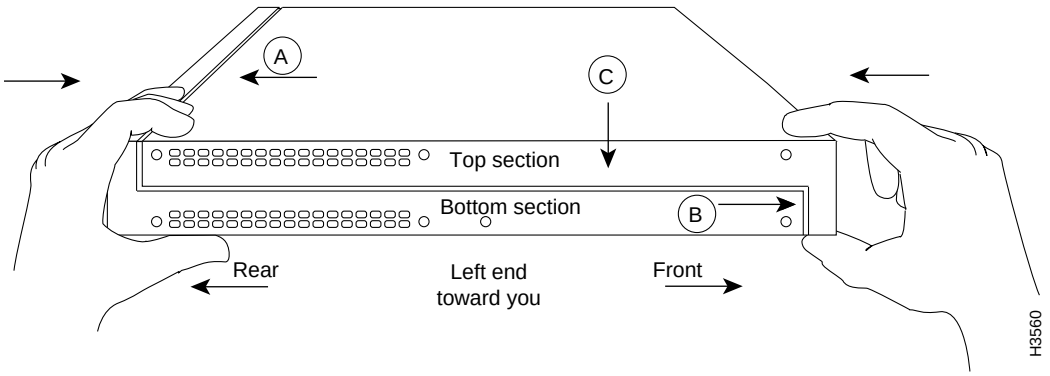
Step 1 Position the two chassis sections, as shown in Figure B-5.

Step 2 Referring to Figure B-5, press the two chassis sections together and ensure the following:

- The top section fits *into* the rear of the bottom section. (See A in Figure B-5.)
- The bottom section fits *into* the front of the top section. (See B in Figure B-5.)
- Each side of the top and bottom sections fits together. (See C in Figure B-5.)

Caution To fit the two sections together, it may be necessary to work them together at one end and then the other, working back and forth; however, use care to prevent bending the chassis edges.

Figure B-5 Replacing the Chassis Cover



Step 3 When the two sections fit together snugly, turn the chassis so that the bottom is facing up, with the front panel toward you.

Step 4 Replace the cover screw. (See Figure B-1.) Tighten the screw to no more than 8 or 9 inch/pounds of torque.

Step 5 Reinstall the chassis on the wall, rack, desktop, or table.

Step 6 Replace all cables.

APPENDIX C

Cable Specifications

This appendix provides the following pinout information:

- Console and Auxiliary Port Signals and Pinouts
- Ethernet Cable Assembly and Pinouts
- Synchronous Serial Cable Assemblies and Pinouts

Note All pins not listed in the tables in this appendix are not connected.

To order cables, see the section “Obtaining Service and Support” in the “Overview of the Router” chapter.

Console and Auxiliary Port Signals and Pinouts

Your router comes with a console and auxiliary cable kit, which contains the cable and adapters you need to connect a console terminal (an ASCII terminal or PC running terminal emulation software) or modem to your access server. The console and auxiliary cable kit includes the following items:

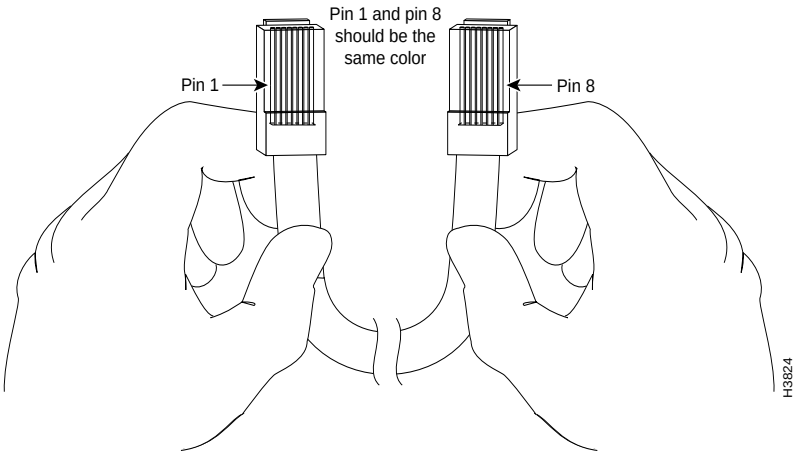
- RJ-45-to-RJ-45 roll-over cable. (See the next section, “Identifying a Roll-Over Cable,” for more information.)
- RJ-45-to-DB-9 female DTE adapter (labeled “TERMINAL”).
- RJ-45-to-DB-25 female DTE adapter (labeled “TERMINAL”).
- RJ-45-to-DB-25 male DCE adapter (labeled “MODEM”).

For console connections, proceed to the section “Console Port Signals and Pinouts” later in this appendix; for modem connections, proceed to the section “Auxiliary Port Signals and Pinouts” later in this appendix.

Identifying a Roll-Over Cable

You can identify a roll-over cable by comparing the two modular ends of the cable. Holding the cables side-by-side, with the tab at the back, the wire connected to the pin on the outside of the left plug should be the same color as the wire connected to the pin on the outside of the right plug. (See Figure C-1.) If your cable came from Cisco Systems, pin 1 will be white on one connector, and pin 8 will be white on the other (a roll-over cable reverses pins 1 and 8, 2 and 7, 3 and 6, and 4 and 5).

Figure C-1 Identifying a Roll-Over Cable



Console Port Signals and Pinouts

Use the thin, flat, RJ-45-to-RJ-45 roll-over cable and RJ-45-to-DB-9 female DTE adapter (labeled “TERMINAL”) to connect the console port to a PC running terminal emulation software. Figure C-2 shows how to connect the console port to a PC. Table C-1 lists the pinouts for the asynchronous serial console port, the RJ-45-to-RJ-45 roll-over cable, and the RJ-45-to-DB-9 female DTE adapter (labeled “TERMINAL”).

Figure C-2 Connecting the Console Port to a PC

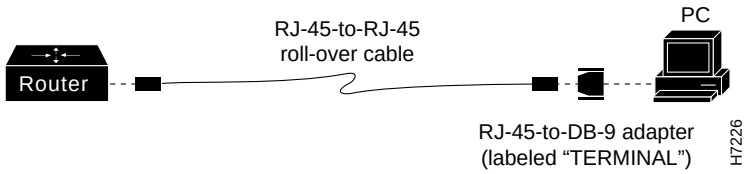


Table C-1 Console Port Signaling and Cabling Using a DB-9 Adapter

Console Port (DTE)	RJ-45-to-RJ-45 Roll-Over Cable		RJ-45-to-DB-9 Terminal Adapter	Console Device
Signal	**RJ-45 Pin**	**RJ-45 Pin**	**DB-9 Pin**	**Signal**
RTS	1[1]	8	8	CTS
DTR	2	7	6	DSR
TxD	3	6	2	RxD
GND	4	5	5	GND
GND	5	4	5	GND
RxD	6	3	3	TxD
DSR	7	2	4	DTR
CTS	8[1]	1	7	RTS

1. Pin 1 is connected internally to Pin 8.

Use the thin, flat, RJ-45-to-RJ-45 roll-over cable and RJ-45-to-DB-25 female DTE adapter (labeled “TERMINAL”) to connect the console port to a terminal. Figure C-3 shows how to connect the console port to a terminal. Table C-2 lists the pinouts for the asynchronous serial console port, the RJ-45-to-RJ-45 roll-over cable, and the RJ-45-to-DB-25 female DTE adapter (labeled “TERMINAL”).

Figure C-3 Connecting the Console Port to a Terminal

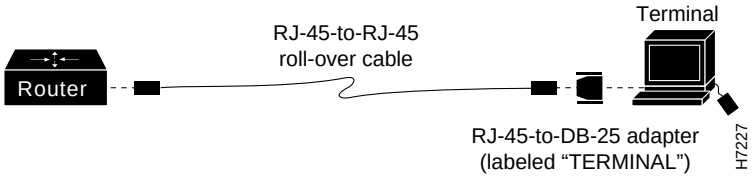


Table C-2 Console Port Signaling and Cabling Using a DB-25 Adapter

Console Port (DTE)[1]	RJ-45-to-RJ-45 Roll-Over Cable		RJ-45-to-DB-25 Terminal Adapter	Console Device
Signal	**RJ-45 Pin**	**RJ-45 Pin**	**DB-25 Pin**	**Signal**
RTS	1[2]	8	5	CTS
DTR	2	7	6	DSR
TxD	3	6	3	RxD
GND	4	5	7	GND
GND	5	4	7	GND
RxD	6	3	2	TxD
DSR	7	2	20	DTR
CTS	8[1]	1	4	RTS

1. You can use the same cabling to connect a console to the auxiliary port.
2. Pin 1 is connected internally to Pin 8.

Auxiliary Port Signals and Pinouts

Use the thin, flat, RJ-45-to-RJ-45 roll-over cable and RJ-45-to-DB-25 male DCE adapter (labeled “MODEM”) to connect the auxiliary port to a modem. Figure C-4 shows how to connect the auxiliary port to a modem. Table C-3 lists the pinouts for the asynchronous serial auxiliary port, the RJ-45-to-RJ-45 roll-over cable, and the RJ-45-to-DB-25 male DCE adapter (labeled “MODEM”).

Figure C-4 Connecting the Auxiliary Port to a Modem

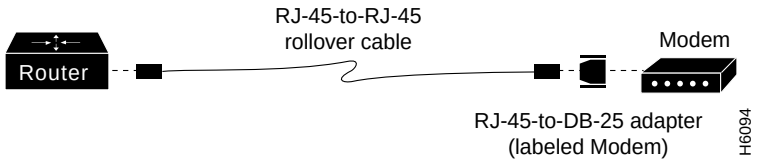


Table C-3 Auxiliary Port Signaling and Cabling Using a DB-25 Adapter

Auxiliary Port (DTE)	RJ-45-to-RJ-45 Roll-Over Cable		RJ-45-to-DB-25 Modem Adapter	Modem
Signal	**RJ-45 Pin**	**RJ-45 Pin**	**DB-25 Pin**	**Signal**
RTS	1[1]	8	4	RTS
DTR	2	7	20	DTR
TxD	3	6	3	TxD
GND	4	5	7	GND
GND	5	4	7	GND
RxD	6	3	2	RxD
DSR	7	2	8	DCD
CTS	8[1]	1	5	CTS

1. Pin 1 is connected internally to Pin 8.

Ethernet Cable Assembly and Pinouts

This section describes the pinouts for an Ethernet AUI cable.

Figure C-5 shows an Ethernet AUI cable assembly, and Table C-4 lists the cable pinouts.

Figure C-5 Ethernet AUI Cable Assembly

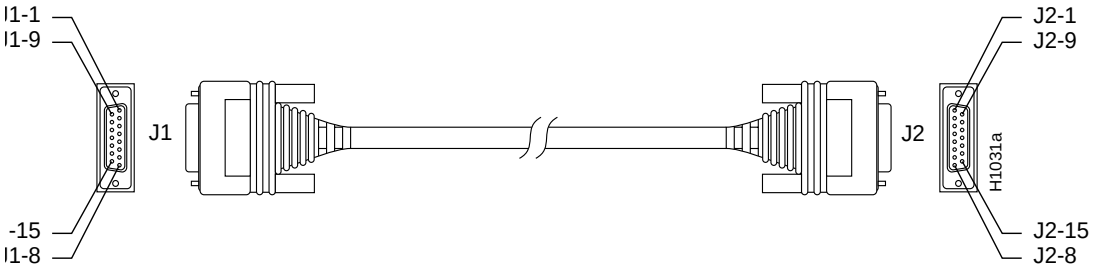


Table C-4 Ethernet AUI Cable Pinouts (DB-15)

Pin	Ethernet Circuit	Signal
3	DO-A	Data Out Circuit A
10	DO-B	Data Out Circuit B
11	DO-S	Data Out Circuit Shield
5	DI-A	Data In Circuit A
12	DI-B	Data In Circuit B
4	DI-S	Data In Circuit Shield
2	CI-A	Control In Circuit A
9	CI-B	Control In Circuit B
1	CI-S	Control In Circuit Shield
6	VC	Voltage Common
13	VP	Voltage Plus

Table C-4 Ethernet AUI Cable Pinouts (DB-15) (Continued)

Pin	Ethernet Circuit	Signal
14	VS	Voltage Shield (L25 and M25)
Shell	PG	Protective Ground

Token Ring Pinout

Table C-5 lists the pinout for the Token Ring interface port.

Table C-5 Token Ring Port Pinout (DB-9)

9 Pin	Signal
1	Receive
3	+5V[1]
5	Transmit
6	Receive
9	Transmit

1. 600 mA maximum.

Synchronous Serial Cable Assemblies and Pinouts

The illustrations and tables in this section provide assembly drawings and pinouts for the EIA-530 DCE, EIA/TIA-232, EIA/TIA-449, V.35, and X.21 DTE and DCE cables, which are used with the synchronous serial WAN port (labeled “SERIAL”).

EIA-530

Figure C-6 shows the EIA-530 serial cable assembly, and Table C-6 lists the pinouts. Arrows indicate signal direction: —> indicates DTE to DCE, and <— indicates DCE to DTE.

Figure C-6 EIA-530 Serial Cable Assembly

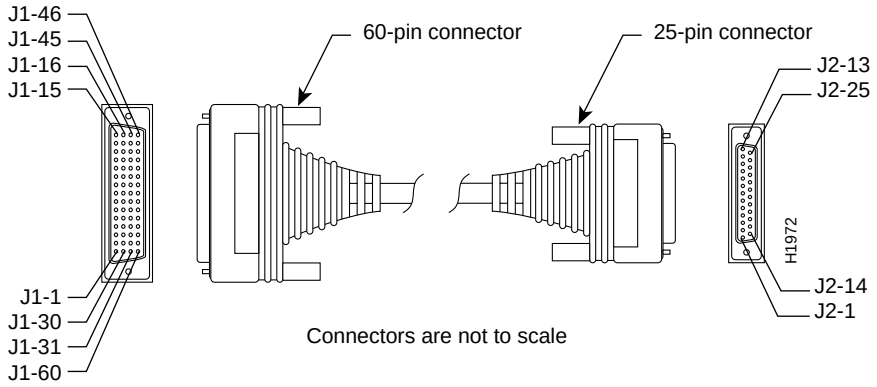


Table C-6 EIA-530 DTE Cable Pinouts (DB-60 to DB-25)

60 Pin	Signal	25 Pin	Signal	Direction DTE DCE[1]
J1-11	TxD/RxD+	J2-2	BA(A), TxD+	—>
J1-12	TxD/RxD–	J2-14	BA(B), TxD–	—>
J1-28	RxD/TxD+	J2-3	BB(A), RxD+	<—
J1-27	RxD/TxD–	J2-16	BB(B), RxD–	<—
J1-9	RTS/CTS+	J2-4	CA(A), RTS+	—>
J1-10	RTS/CTS–	J2-19	CA(B), RTS–	—>
J1-1	CTS/RTS+	J2-5	CB(A), CTS+	<—
J1-2	CTS/RTS–	J2-13	CB(B), CTS–	<—
J1-3	DSR/DTR+	J2-6	CC(A), DSR+	<—
J1-4	DSR/DTR–	J2-22	CC(B), DSR–	<—
J1-46	Shield_GND	J2-1	Shield	Shorted
J1-47	MODE_2	–	–	
J1-48	GND	–	–	Shorted
J1-49	MODE_1	–	–	
J1-5	DCD/DCD+	J2-8	CF(A), DCD+	<—
J1-6	DCD/DCD–	J2-10	CF(B), DCD–	<—
J1-24	TxC/RxC+	J2-15	DB(A), TxC+	<—
J1-23	TxC/RxC–	J2-12	DB(B), TxC–	<—
J1-26	RxC/TxCE+	J2-17	DD(A), RxC+	<—
J1-25	RxC/TxCE–	J2-9	DD(B), RxC–	<—
J1-44	LL/DCD	J2-18	LL	—>
J1-45	Circuit_GND	J2-7	Circuit_ GND	–

Table C-6 EIA-530 DTE Cable Pinouts (DB-60 to DB-25) (Continued)

60 Pin	Signal	25 Pin	Signal	Direction DTE DCE[1]
J1-7	DTR/DSR+	J2-20	CD(A), DTR+	—>
J1-8	DTR/DSR–	J2-23	CD(B), DTR–	—>
J1-13	TxCE/TxC+	J2-24	DA(A), TxCE+	—>
J1-14	TxCE/TxC–	J2-11	DA(B), TxCE–	—>
J1-51	GND	—	—	Shorted
J1-52	MODE_DCE	—	—	

1. The EIA-530 interface operates in DTE mode only. A DCE cable is not available for the EIA-530 interface.

EIA/TIA-232

Figure C-7 shows the EIA/TIA-232 cable assembly. Table C-7 lists the DTE pinouts. Table C-8 lists the DCE pinouts. Arrows indicate signal direction: —> indicates DTE to DCE, and <— indicates DCE to DTE.

Figure C-7 EIA/TIA-232 Cable Assembly

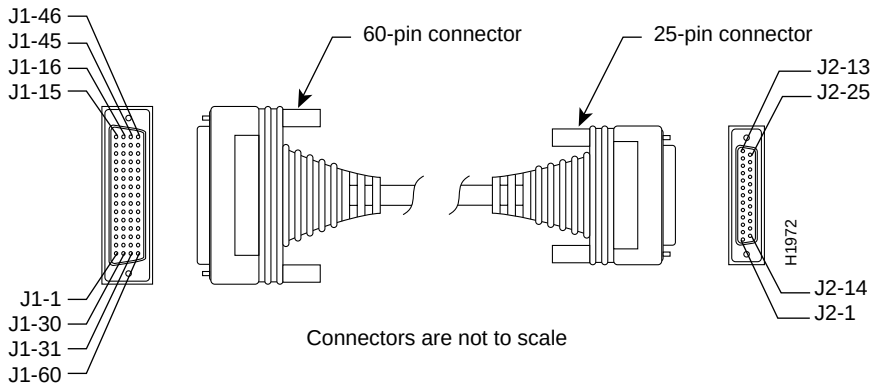


Table C-7 EIA/TIA-232 DTE Cable Pinouts (DB-60 to DB-25)

60 Pin	Signal	Description	Direction	25 Pin	Signal
J1-50	MODE_0	Shorting group	–	–	–
J1-51	GND				
J1-52	MODE_DCE				
J1-46	Shield GND	Single	–	J2-1	Shield GND
J1-41	TxD/RxD	Twisted pair no. 5	—>	J2-2	TxD
Shield	–		–	Shield	–
J1-36	RxD/TxD	Twisted pair no. 9	<—	J2-3	RxD
Shield	–		–	Shield	–
J1-42	RTS/CTS	Twisted pair no. 4	—>	J2-4	RTS
Shield	–		–	Shield	–
J1-35	CTS/RTS	Twisted pair no. 10	<—	J2-5	CTS
Shield	–		–	Shield	–
J1-34	DSR/DTR	Twisted pair no. 11	<—	J2-6	DSR
Shield	–		–	Shield	–
J1-45	Circuit GND	Twisted pair no. 1	–	J2-7	Circuit GND
Shield	–		–	Shield	–
J1-33	DCD/LL	Twisted pair no. 12	<—	J2-8	DCD
Shield	–		–	Shield	–
J1-37	TxC/NIL	Twisted pair no. 8	<—	J2-15	TxC
Shield	–		–	Shield	–

Table C-7 EIA/TIA-232 DTE Cable Pinouts (DB-60 to DB-25) (Continued)

60 Pin	Signal	Description	Direction	25 Pin	Signal
J1-38	RxC/TxCE	Twisted pair no. 7	<—	J2-17	RxC
Shield	–		–	Shield	–
J1-44	LL/DCD	Twisted pair no. 2	—>	J2-18	LTST
Shield	–		–	Shield	–
J1-43	DTR/DSR	Twisted pair no. 3	—>	J2-20	DTR
Shield	–		–	Shield	–
J1-39	TxCE/TxC	Twisted pair no. 6	—>	J2-24	TxCE
Shield	–		–	Shield	–

Table C-8 EIA/TIA-232 DCE Cable Pinouts (DB-60 to DB-25)

60 Pin	Signal	Description	Direction	25 Pin	Signal
J1-50	MODE_0	Shorting group	–	–	–
J1-51	GND				
J1-46	Shield GND	Single	–	J2-1	Shield GND
J1-36	RxD/TxD	Twisted pair no. 9	<—	J2-2	TxD
Shield	–		–	Shield	–
J1-41	TxD/RxD	Twisted pair no. 5	—>	J2-3	RxD
Shield	–		–	Shield	–
J1-35	CTS/RTS	Twisted pair no. 10	<—	J2-4	RTS
Shield	–		–	Shield	–
J1-42	RTS/CTS	Twisted pair no. 4	—>	J2-5	CTS
Shield	–		–	Shield	–

Table C-8 EIA/TIA-232 DCE Cable Pinouts (DB-60 to DB-25) (Continued)

60 Pin	Signal	Description	Direction	25 Pin	Signal
J1-43	DTR/DSR	Twisted pair no. 3	—>	J2-6	DSR
Shield	–		–	Shield	–
J1-45	Circuit GND	Twisted pair no. 1	–	J2-7	Circuit GND
Shield	–		–	Shield	
J1-44	LL/DCD	Twisted pair no. 2	—>	J2-8	DCD
Shield	–		–	Shield	–
J1-39	TxCE/TxC	Twisted pair no. 7	—>	J2-15	TxC
Shield	–		–	Shield	–
J1-40	NIL/RxC	Twisted pair no. 6	—>	J2-17	RxC
Shield	–		–	Shield	–
J1-33	DCD/LL	Twisted pair no. 12	<—	J2-18	LTST
Shield	–		–	Shield	–
J1-34	DSR/DTR	Twisted pair no. 11	<—	J2-20	DTR
Shield	–		–	Shield	–
J1-38	RxC/TxCE	Twisted pair no. 8	<—	J2-24	TxCE
Shield	–		–	Shield	–

EIA/TIA-449

Figure C-8 shows the EIA/TIA-449 cable assembly. Table C-9 lists the DTE pinouts. Table C-10 lists the DCE pinouts. Arrows indicate signal direction: —> indicates DTE to DCE, and <— indicates DCE to DTE.

Figure C-8 EIA/TIA-449 Cable Assembly

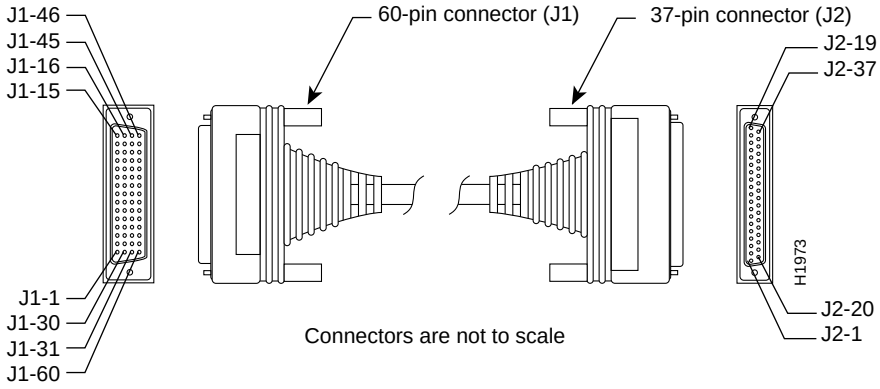


Table C-9 EIA/TIA-449 DTE Cable Pinouts (DB-60 to DB-37)

60 Pin	Signal	Description	Direction	37 Pin	Signal
J1-49	MODE_1	Shorting group	–	–	–
J1-48	GND				
J1-51	GND	Shorting group	–	–	–
J1-52	MODE_DCE				
J1-46	Shield_GND	Single	_	J2-1	Shield GND
J1-11	TxD/RxD+	Twisted pair no. 6	—>	J2-4	SD+
J1-12	TxD/RxD–		—>	J2-22	SD–
J1-24	TxC/RxC+	Twisted pair no. 9	<—	J2-5	ST+
J1-23	TxC/RxC–		<—	J2-23	ST–

Table C-9 EIA/TIA-449 DTE Cable Pinouts (DB-60 to DB-37) (Continued)

60 Pin	Signal	Description	Direction	37 Pin	Signal
J1-28	RxD/TxD+	Twisted pair no. 11	<—	J2-6	RD+
J1-27	RxD/TxD–		<—	J2-24	RD–
J1-9	RTS/CTS+	Twisted pair no. 5	—>	J2-7	RS+
J1-10	RTS/CTS–		—>	J2-25	RS–
J1-26	RxC/TxCE+	Twisted pair no. 10	<—	J2-8	RT+
J1-25	RxC/TxCE–		<—	J2-26	RT–
J1-1	CTS/RTS+	Twisted pair no. 1	<—	J2-9	CS+
J1-2	CTS/RTS–		<—	J2-27	CS–
J1-44	LL/DCD	Twisted pair no. 12	—>	J2-10	LL
J1-45	Circuit_GND		_	J2-37	SC
J1-3	DSR/DTR+	Twisted pair no. 2	<—	J2-11	DM+
J1-4	DSR/DTR–		<—	J2-29	DM–
J1-7	DTR/DSR+	Twisted pair no. 4	—>	J2-12	TR+
J1-8	DTR/DSR–		—>	J2-30	TR–
J1-5	DCD/DCD+	Twisted pair no. 3	<—	J2-13	RR+
J1-6	DCD/DCD–		<—	J2-31	RR–
J1-13	TxCE/TxC+	Twisted pair no. 7	—>	J2-17	TT+
J1-14	TxCE/TxC–		—>	J2-35	TT–
J1-15	Circuit_GND	Twisted pair no. 9	–	J2-19	SG
J1-16	Circuit_GND		–	J2-20	RC

Table C-10 EIA/TIA-449 DCE Cable Pinouts (DB-60 to DB-37)

60 Pin	Signal	Description	Direction	37 Pin	Signal
J1-49	MODE_1	Shorting group	–	–	–
J1-48	GND				

Table C-10 EIA/TIA-449 DCE Cable Pinouts (DB-60 to DB-37) (Continued)

60 Pin	Signal	Description	Direction	37 Pin	Signal
J1-46	Shield_GND	Single	–	J2-1	Shield GND
J1-28	RxD/TxD+	Twisted pair no. 11	<—	J2-4	SD+
J1-27	RxD/TxD–		<—	J2-22	SD–
J1-13	TxCE/TxC+	Twisted pair no. 7	—>	J2-5	ST+
J1-14	TxCE/TxC–		—>	J2-23	ST–
J1-11	TxD/RxD+	Twisted pair no. 6	—>	J2-6	RD+
J1-12	TxD/RxD–		—>	J2-24	RD–
J1-1	CTS/RTS+	Twisted pair no. 1	<—	J2-7	RS+
J1-2	CTS/RTS–		<—	J2-25	RS–
J1-24	TxC/RxC+	Twisted pair no. 9	—>	J2-8	RT+
J1-23	TxC/RxC–		—>	J2-26	RT–
J1-9	RTS/CTS+	Twisted pair no. 5	—>	J2-9	CS+
J1-10	RTS/CTS–		—>	J2-27	CS–
J1-29	NIL/LL	Twisted pair no. 12	—>	J2-10	LL
J1-30	Circuit_GND		–	J2-37	SC
J1-7	DTR/DSR+	Twisted pair no. 4	—>	J2-11	DM+
J1-8	DTR/DSR–		—>	J2-29	DM–
J1-3	DSR/DTR+	Twisted pair no. 2	<—	J2-12	TR+
J1-4	DSR/DTR–		<—	J2-30	TR–
J1-5	DCD/DCD+	Twisted pair no. 3	—>	J2-13	RR+
J1-6	DCD/DCD–		—>	J2-31	RR–
J1-26	RxC/TxCE+	Twisted pair no. 10	<—	J2-17	TT+
J1-25	RxC/TxCE–		<—	J2-35	TT–
J1-15	Circuit_GND	Twisted pair no. 8	_	J2-19	SG
J1-16	Circuit_GND		_	J2-20	RC

V.35

Figure C-9 shows the V.35 cable assembly. Table C-11 lists the DTE pinouts. Table C-12 lists the DCE pinouts. Arrows indicate signal direction: —> indicates DTE to DCE, and <— indicates DCE to DTE.

Figure C-9 V.35 Cable Assembly

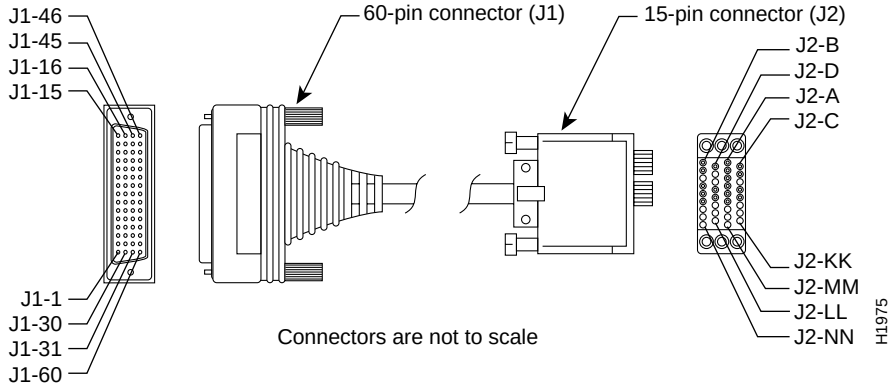


Table C-11 V.35 DTE Cable Pinouts (DB-60 to 34-Pin)

60 Pin	Signal	Description	Direction	34 Pin	Signal
J1-49	MODE_1	Shorting group	–	–	–
J1-48	GND				
J1-50	MODE_0	Shorting group	–	–	–
J1-51	GND				
J1-52	MODE_DCE				
J1-53	TxC/NIL	Shorting group	–	–	–
J1-54	RxC_TxCE				
J1-55	RxD/TxD				
J1-56	GND				

Table C-11 V.35 DTE Cable Pinouts (DB-60 to 34-Pin) (Continued)

60 Pin	Signal	Description	Direction	34 Pin	Signal
J1-46	Shield_GND	Single	–	J2-A	Frame GND
J1-45	Circuit_GND	Twisted pair no. 12	–	J2-B	Circuit GND
Shield	–		–	Shield	–
J1-42	RTS/CTS	Twisted pair no. 9	—>	J2-C	RTS
Shield	–		–	Shield	–
J1-35	CTS/RTS	Twisted pair no. 8	<—	J2-D	CTS
Shield	–		–	Shield	–
J1-34	DSR/DTR	Twisted pair no. 7	<—	J2-E	DSR
Shield	–		–	Shield	–
J1-33	DCD/LL	Twisted pair no. 6	<—	J2-F	RLSD
Shield	–		–	Shield	–
J1-43	DTR/DSR	Twisted pair no. 10	—>	J2-H	DTR
Shield	–		–	Shield	–
J1-44	LL/DCD	Twisted pair no. 11	—>	J2-K	LT
Shield	–		–	Shield	–
J1-18	TxD/RxD+	Twisted pair no. 1	—>	J2-P	SD+
J1-17	TxD/RxD–		—>	J2-S	SD–
J1-28	RxD/TxD+	Twisted pair no. 5	<—	J2-R	RD+
J1-27	RxD/TxD–		<—	J2-T	RD–
J1-20	TxCE/TxC+	Twisted pair no. 2	—>	J2-U	SCTE+
J1-19	TxCE/TxC–		—>	J2-W	SCTE–
J1-26	RxC/TxCE+	Twisted pair no. 4	<—	J2-V	SCR+
J1-25	RxC/TxCE–		<—	J2-X	SCR–
J1-24	TxC/RxC+	Twisted pair no. 3	<—	J2-Y	SCT+
J1-23	TxC/RxC–		<—	J2-AA	SCT–

Table C-12 V.35 DCE Cable Pinouts (DB-60 to 34-Pin)

60 Pin	Signal	Description	Direction	34 Pin	Signal
J1-49	MODE_1	Shorting group	–	–	–
J1-48	GND				
J1-50	MODE_0	Shorting group	–	–	–
J1-51	GND				
J1-53	TxC/NIL	Shorting group	–	–	–
J1-54	RxC_TxCE				
J1-55	RxD/TxD				
J1-56	GND				
J1-46	Shield_GND	Single	–	J2-A	Frame GND
J1-45	Circuit_GND	Twisted pair no. 12	–	J2-B	Circuit GND
Shield	–		–	Shield	–
J1-35	CTS/RTS	Twisted pair no. 8	<—	J2-C	RTS
Shield	–		–	Shield	–
J1-42	RTS/CTS	Twisted pair no. 9	—>	J2-D	CTS
Shield	–		–	Shield	–
J1-43	DTR/DSR	Twisted pair no. 10	—>	J2-E	DSR
Shield	–		–	Shield	–
J1-44	LL/DCD	Twisted pair no. 11	—>	J2-F	RLSD
Shield	–		–	Shield	–
J1-34	DSR/DTR	Twisted pair no. 7	<—	J2-H	DTR
Shield	–		–	Shield	–
J1-33	DCD/LL	Twisted pair no. 6	<—	J2-K	LT
Shield	–		–	Shield	–
J1-28	RxD/TxD+	Twisted pair no. 5	<—	J2-P	SD+
J1-27	RxD/TxD–		<—	J2-S	SD–

Table C-12 V.35 DCE Cable Pinouts (DB-60 to 34-Pin) (Continued)

60 Pin	Signal	Description	Direction	34 Pin	Signal
J1-18	TxD/RxD+	Twisted pair no. 1	—>	J2-R	RD+
J1-17	TxD/RxD–		—>	J2-T	RD–
J1-26	RxC/TxCE+	Twisted pair no. 4	<—	J2-U	SCTE+
J1-25	RxC/TxCE–		<—	J2-W	SCTE–
J1-22	NIL/RxC+	Twisted pair no. 3	—>	J2-V	SCR+
J1-21	NIL/RxC–		—>	J2-X	SCR–
J1-20	TxCE/TxC+	Twisted pair no. 2	—>	J2-Y	SCT+
J1-19	TxCE/TxC–		—>	J2-AA	SCT–

X.21

Figure C-10 shows the X.21 cable assembly. Table C-13 lists the DTE pinouts. Table C-14 lists the DCE pinouts. Arrows indicate signal direction: —> indicates DTE to DCE, and <— indicates DCE to DTE.

Figure C-10 X.21 Cable Assembly

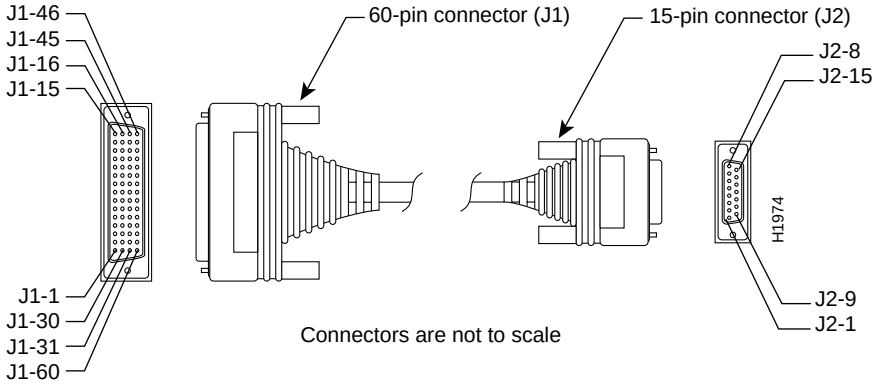


Table C-13 X.21 DTE Cable Pinouts (DB-60 to DB-15)

60 Pin	Signal	Description	Direction	15 Pin	Signal
J1-48	GND	Shorting group	–	–	–
J1-47	MODE_2				
J1-51	GND	Shorting group	–	–	–
J1-52	MODE_DCE				
J1-46	Shield_GND	Single	–	J2-1	Shield GND
J1-11	TxD/RxD+	Twisted pair no. 3	—>	J2-2	Transmit+
J1-12	TxD/RxD–		—>	J2-9	Transmit–
J1-9	RTS/CTS+	Twisted pair no. 2	—>	J2-3	Control+
J1-10	RTS/CTS–		—>	J2-10	Control–
J1-28	RxD/TxD+	Twisted pair no. 6	<—	J2-4	Receive+
J1-27	RxD/TxD–		<—	J2-11	Receive–
J1-1	CTS/RTS+	Twisted pair no. 1	<—	J2-5	Indication+
J1-2	CTS/RTS–		<—	J2-12	Indication–
J1-26	RxC/TxCE+	Twisted pair no. 5	<—	J2-6	Timing+
J1-25	RxC/TxCE–		<—	J2-13	Timing–
J1-15	Control_GND	Twisted pair no. 4	–	J2-8	Control GND
Shield	–		–	Shield	–

Table C-14 X.21 DCE Cable Pinouts (DB-60 to DB-15)

60 Pin	Signal	Description	Direction	15 Pin	Signal
J1-48	GND	Shorting group	–	–	–
J1-47	MODE_2				
J1-46	Shield_GND	Single	–	J2-1	Shield GND
J1-28	RxD/TxD+	Twisted pair no. 6	<—	J2-2	Transmit+
J1-27	RxD/TxD–		<—	J2-9	Transmit–
J1-1	CTS/RTS+	Twisted pair no. 1	<—	J2-3	Control+
J1-2	CTS/RTS–		<—	J2-10	Control–
J1-11	TxD/RxD+	Twisted pair no. 3	—>	J2-4	Receive+
J1-12	TxD/RxD–		—>	J2-11	Receive–
J1-9	RTS/CTS+	Twisted pair no. 2	—>	J2-5	Indication+
J1-10	RTS/CTS–		—>	J2-12	Indication–
J1-24	TxC/RxC+	Twisted pair no. 4	—>	J2-6	Timing+
J1-23	TxC/RxC–		—>	J2-13	Timing–
J1-15	Control_GND	Twisted pair no. 5	–	J2-8	Control GND
Shield	–		–	Shield	–